THE

ELECTRICAL REVIEW.

VOL. LXVIII. APRIL 21, 1911. No. 1,743.

ELECTRICAL REVIEW.

Vol. LXVIII.] CONTENTS: April 21, 1911. [No. 1,743.

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THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address.: "AGEKKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

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SUBSCRIPTION RATES.—Per annum, postage inclusive, in Great Britain, 18s. 6d.; Canada, £1 1s. 8d. ($5.30). To all other countries, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. Paris: BOYVEAU & CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

NOW READY.

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1911 EDITION

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

INTELLECTUAL PROPERTY.

THE debate on April 7th in the House of Commons on the subject of Copyright reached a high level of interest, and showed the House of Commons in one of its best lights, the subject being thoroughly congenial to many members of literary and intellectual attainments.

The new Copyright Bill provides for the protection of what the French call intellectual property, for the whole of the author's lifetime and 50 years after his death, as against the existing period of protection of 42 years from the date of publication. It covers not only books, but music, lectures, paintings, engravings, sculpture, drawings, and photography—even architectural designs.

There can be no doubt that there is an enormous majority of the House in favour of this great extension of the protection of the law for the products of man's brain enumerated above. The list is fairly comprehensive, and it is not very clear that the present system of registering designs will not be entirely superseded. We are not going to discuss here the question as affecting Literature, even though its application to technical works would fall within our proper sphere. But we propose to revert to a subject often ventilated in these columns—viz., the question of the Patent Law. Why should the poet, the novelist, the draughtsman, even the architect, secure full protection for the fruits of his labour and his thought for the whole of his life, and for the lives of his children who come after him, at a small and non-recurring expense, while the inventor alone is to be singled out for contempt or spoliation?

Far be it from us to belittle the works of genius; they form the mechanism that moves the world. Great literature is still scarce enough, and we hold that hardly any inducement to its pursuit is too costly. But of what use is literature to those who have no leisure to enjoy it or to profit by its lessons? Surely, if the matter be regarded from the standpoint of the general public, it is necessary first that everything should be done that is possible to forward those labour-saving inventions or time-creating devices which have already done so much to provide a higher scale of existence for the masses, and to place within their reach those voyages into the realms of the spirit and the intellect which have been, till recently, the privilege of the leisured few. Some of the heroes of literature and music were mentioned—men who toiled and starved so that their fellows might have light. What of the heroes of Invention—labouring in obscurity, often in misery and contempt, to lighten the burden of humanity, to shorten the day's work—to cheapen the means of life, the means of travel, the means of production; even the printing of books for the multitude to read?

These men have not even protection for the term of their natural lives. Fifty years' security for the products of their

brains for the benefit of their children is a boon for which they would never dream of asking. How far do we go to assist and encourage such men?

Mr. Balfour illustrated once more the aloofness from some practical matters of the classical mind. He said, "Property in a patent is property in *nothing but an idea*." Is it not lamentable that a man in his position should not know that an *idea* is the very thing you cannot patent, either here or elsewhere? You must file documents and drawings sufficient to show the man versed in the particular trade affected how to carry your invention into practical effect. You must do this first to satisfy the Patent Office, and afterwards, if your patent is successful, and you should have to defend it, as you almost certainly will, in the Law Courts, your patent will be declared null and void if your opponent can show that in any one particular you failed to indicate the exact means of putting it into use. The contempt for the poor patentee reaches its climax in this great modern industrial Empire.

In the United States they know better, and that is one reason why their wealth is increasing at its present enormous rate—wealth that will one day give to its ordinary citizens (when they come into their inheritance) a large share of the world's leisure and the world's culture. In the States a patentee pays £7 down and secures 17 years' real protection. This does not compare very favourably with copyright, but how do we stand? We impose an enormous brain tax. If the inventor struggles to pay it for the first 10 years and then fails to pay the yearly increasing demand, his "intellectual property" is promptly forfeited—absolutely and finally. His 14 years' protection can only be secured at a total cost of about £100.

If his patent is attacked, does the Government lend him support? On the contrary, he must defend himself in the Courts, and lucky he must consider himself if he escape the hundred-and-one cunning lawyers' pitfalls that seem specially designed by our patent enactments to defeat him.

If his main claims (the real *essence* of his invention) stand good, but he has claimed some minor detail which can be shown to be not absolutely novel, his intellectual property is *confiscated*. To be sure, he can apply for amendment, pay the costs of both sides, and start all over again; but few patentees can stand two campaigns of this kind.

Only three per cent. of the patents taken out are maintained for their full term. This shows the wretched return to the inventor as clearly as figures can show it.

The annual report of the Patent Office is just out, and shows a balance of receipts over expenditure of nearly £100,000, paid over to the Treasury—the total yield for the year of the Brain Tax.

As long as a penny of profit is made we shall continue to denounce the policy of the Treasury. There might be *some* plausible pretext for keeping up the fees, but if so, the £100,000 a year should be spent for the benefit of progress in acquiring inventions of general utility to the State, in helping to defend patents against infringement, in disseminating useful information (for instance, keeping the specifications in print) and so forth. The present national policy is that of the sweater who grinds his victim below the point at which he can render useful service. It kills the goose that lays the golden eggs.

Electricity in Mines.

We have on more than one occasion referred to Home Office prosecutions of mine managers for failing to carry out the provisions of the Special Electricity Rules, and, as we have already reported, in the Hamilton Sheriff Court recently, Mr. Robert McKay, the resident manager of the Cornsilloch Colliery, belonging to Messrs. Archibald Russel, Ltd., and Mr. James Salmond, the agent for the company, were prosecuted, the former for (1) failing sufficiently to cover the electric haulage motor; (2) failing to have the frame of the motor sufficiently earthed; (3) failing to have the terminal and starting switch sufficiently covered; (4) failing to protect efficiently or suitably an electric wire and joint, and (5) for suspending electrical cables on iron nails instead of by leather or other flexible material; while the charge against Mr. Salmond was that he "failed to have a competent person on duty at the pit where electrical apparatus and machinery were in use."

From the evidence, it appears that the plant had been installed *previously* to the introduction of the Special Rules, and the management assumed—rightly or wrongly—as very many others have done and do still, that because of this the rules did not apply; they further assumed that, if it was necessary for them to comply with the rules, the District Inspector of Mines should have given them notice to this effect, and evidently Sheriff Shennan, who adjudicated, thought this a more or less reasonable view to take. It is also to be noted that no accident had occurred with the plant. In the end, so far as the charges relating to Mr. McKay were concerned, the Sheriff found that the first and second were both breaches of the rules, the third and fourth failed on the ground that both related to the installation previously to the existence of the rules, but he convicted on the fifth, as it clearly related to the improper suspension of the cables. He further added that the offences did not seem to be very heinous in this case, and that apparently managers not unnaturally interpreted Rule 55 as meaning that the Special Rules did not apply to them, and went on from day to day without any trouble arising, and he thought it fair to let the accused off with an admonition.

The chief point of interest in the case is the charge relating to the non-employment of a "competent" person, against Mr. Salmond. On the date of the complaint, H.M. Electrical Inspector made an inspection of the plant, and asked to see the engineer-in-charge, when Mr. Robert Young was introduced to him as the person responsible, and in the *opinion of the management* "competent." Mr. Young, in his evidence, stated that he been 20 years in the service of the respondents, and was in charge of all the mechanical and electrical appliances at the colliery. One of H.M. Inspectors of Mines when making an underground inspection raised some question with the "oversman" as to the "earthing" of the frame of the motor, and Mr. Young altered the earth connection as the "oversman assured him that H.M. Inspector had raised objections to the principle." He also "considered the earthing system he had in operation was quite efficient, and its efficacy was proved by the fact that there had been no leakages, while no complaint had ever at any time been made to him." We have no details before us as to how the earth connection was made, or as to how H.M. Electrical Inspector considers it ought to have been made, and therefore are unable to express any opinion on this point, but in the opinion of the Inspector the defects which he found in the installation "reflected on the competency of Young." He was asked in cross-examination to define the "competent" person, but had to admit that "no definition had as yet been given to the term by the Legislature. He had experienced the same difficulty that other people had felt in defining the word." Yet under the proposed new Electricity Rules, this question is left undecided, which circumstance we have already commented upon in a previous article.

For the defence, it was pointed out that Mr. Salmond was responsible for no fewer than 20 pits, and personally he had nothing whatever to do with the appointment of the "competent" persons. This is—and must always be, so long as the law stands as at present—the prerogative of the resident colliery manager, and it is difficult to see why the Home Office should ever have thought to make the *agent* responsible. The Sheriff dismissed the case on its merits. In giving his decision, however, he said that he would not deal with the question whether the agent was responsible for the appointing of the competent persons, because, in his opinion, the evidence was that the respondent was entitled to regard John Young, the engineer, as a *competent* person.

There is not the least doubt that after the new rules are adopted similar cases to the above will occur, unless

the question be settled in some way or other before they come into force. Under the proposed rules an "electrician" must be competent for the work he has to do, and must be appointed in writing by the manager. But no definition of the term "competent" is given, or as to who is to be the judge whether the person appointed is competent; consequently Mr. McKay is quite within his right to consider Mr. Young competent, and to appoint him in writing as the "electrician." He may also appoint the colliery "handy-man" as the "assistant electrician." H.M. Electrical Inspector may give it as his opinion that the "electrician" is not competent, and may cause the "manager" to be prosecuted for a breach of the rules, and—as very often happens—he may not obtain a conviction. The view of the colliery management is—and rightly so—that so long as they are to carry the responsibility of the person in charge of the plant, they ought to have the right to say whether he is competent or not, and until the Legislature decides that the "competent" person shall be competent by training and examination, and that this person and not the manager shall be responsible for the proper installation and working of the equipment, there will be no end to the question. It is the only solution possible, and it is extremely difficult to see why it is not adopted, as no real reasonable or sensible objections have ever been raised against it.

Wireless Telegraphy and its Scope.

A perusal of the paper read by Mr. J. E. Taylor on wireless telegraph working in relation to interferences and perturbations will enable the layman to comprehend, if he has time to read or think, more fully the difficulties surrounding a system which he has been led to believe is a serious competitor of cables. Reports are periodically seen in prominent dailies to the effect that communication has been established over long ranges, and there is no doubt that long distances are covered occasionally by stations of limited radius, but such achievements may be described as "freaks." We have often stated that the proper function for wireless is to establish communication between ships, ships and shore, or between adjacent islands, where the physical conditions are suitable, and the traffic is small. Wireless companies, manufacturing or otherwise, do not actively enter the field to compete against cables; and the British Government has not acquired long-distance trans-Atlantic stations, but only those of limited radius intended for ship-to-shore work.

Actual experience has shown that sometimes for the whole or the greater part of a business day the system is unworkable owing to atmospheric or other perturbations, which do not affect cable working, and for which no one knows the remedy. Besides these, other influences are at work which render successful communication difficult, and in this connection it may be noted that in the discussion Sir Oliver Lodge stated that the way operators picked out the thing they had to attend to, from the midst of a perfect babel of other communications, struck him as most skilful. What would happen at sea, not when everybody was trying to give way and be polite, but in time of war, when they were trying to disturb everyone else, he did not know, but he did not think that the Admiralty ought to be satisfied with what might turn out to be a very dangerous state of things. These remarks, coming from an inventor of a wireless system, are highly significant. Even when peace reigns, as the author of the paper admits, "shouting down" or "jamming" is of frequent occurrence. Another point also is that important commercial messages have to wait when Government stations on ship or shore are working, as they "jam" most conscientiously.

Since wireless was spoken of as a likely competitor, no less than about 90,000 nautical miles of cable have been laid by various companies at a cost of £9,000,000, or thereabouts; it is clear, therefore, that the cable companies have no fear of effective competition being offered by wireless telegraphy.

Street Lighting.

We recently received from Mr. H. Tomlinson-Lee, chief electrical engineer to the borough of Wimbledon, a sheet of statistics relating to street lighting in 31 towns and boroughs, mainly in the metropolitan area. As a pioneer in street lighting with electrical incandescent lamps, Mr. Tomlinson-Lee is naturally deeply interested in this subject, and we note that in his borough 46 miles of streets are lighted with 91 arc and 1,136 incandescent lamps, no gas being used at all. The total annual cost is £6,645, or £145 per mile, and the total cost per candle-power per annum is 5·08d.—that is, ⅛d. more than the average cost per electrical candle-power (4·96d.) for all the places tabulated. The candle-power per mile is 6,839.

In Deptford, where gas lighting alone is used, 50 miles of streets are lighted with 1,899 gas lamps, giving an illumination of 2,416 c.p. per mile, and costing £4,766 per annum, or at the rate of £95 per mile, and 9·46d. per c.p. per annum. It will be noticed that the average c.p. per gas lamp is about 64, so that evidently incandescent mantles are used, and these cost nearly twice as much per c.p. per annum as the electric lamps in Wimbledon.

In Camberwell also gas alone is used in 132 miles of streets, giving 2,066 c.p. per mile, at the rate of 60 c.p. per lamp. The annual cost per c.p. is 10·57d.

The lowest cost for gas is found in Chelsea, where inverted burners are used, and the annual cost per c.p. is given as 5·52d.—more than ½d. above the *average* cost per c.p. for electric lighting given above.

In Holborn (all gas) the average c.p. per lamp is 96, and the c.p. per mile of street is 7,184, the cost per c.p. per annum being 9·21d. Paddington, with an average of 61 c.p. per lamp, works out at 11·41d. per c.p. per annum, and Wood Green, where gas alone is used, with 79 c.p. per lamp, at 8·49d. The cost per gas c.p. per annum for all the places cited varies from 5·52d. to as much as 21·63d., the average being 12·25d.

The only borough in the list besides Wimbledon, where electric lighting is used throughout, and the costs are available, is Leyton; here the c.p. per mile is 4,119, and the cost per c.p. per annum is 7·57d. But there are 21 places where a considerable amount of electric lighting is employed, the cost per c.p. per annum varying from 2·34d. (Portsmouth) to 10·4d. (Poplar); the average cost works out, as stated above, at 4·96d. Of 18 places where electric light is used, 11 show a cost per c.p. less than 5d. per annum; not one of the results given for gas comes out at less than 5½d.

In view of these results it will be seen that electric street lighting with arc and incandescent lamps leaves gas lighting far in the rear as regards economy. Moreover, both arc and metallic-filament lamps maintain their efficiency almost unimpaired throughout their lives, whereas it is notorious that gas mantles rapidly fall off in illuminating power and require frequent renewal. Lives of 3,000 hours and upwards are commonly reported for metallic-filament lamps, and the prices of the latter, in sizes such as are used for street lighting, have just been lowered, as announced elsewhere in our columns to-day.

Mr. Tomlinson-Lee offers no comment on the interesting figures which he has collected, but we can imagine that he regards them with justifiable satisfaction; they amply bear out the confidence with which electrical engineers look forward to an immense increase in electric street lighting in the future—a movement which is already in full swing, for there is hardly a town in the kingdom with an electricity supply where electric lamps are not being used to a greater or less extent for public lighting, and the tendency is undoubtedly towards extension.

We do not ignore the fact that probably high-pressure gas lighting will show better results than those before us; but we have no fear on this score. If the inclusive cost of high-pressure gas lighting can be brought down to about half that of low-pressure lighting, it will still be at a disadvantage in competition with modern electric street lighting.

D

MR. P. W. SOTHMAN.

We are enabled to publish herewith a photograph of Mr. P. W. Sothman, chief engineer of the Hydro-Electric Power Commission of Ontario, who will shortly be in this country. It has been his intention to read a paper before the Institution of Electrical Engineers here concerning the 110,000-volt transmission line which he has designed and carried out for the Ontario Government for supplying the province with power from the Niagara Falls. Whether it will be possible for that expectation to be realised is at the moment somewhat open to doubt, as the Council of the Institution does not leave its choice of papers to the last moment, and the session is already very far advanced, while, naturally enough, the arrangements for the few remaining meetings are made. Mr. Sothman's work, however, whether the paper is read this session or not, is of such importance and of such a character as to make him a personality of some interest in the United Kingdom as well as in Canada. From a recent issue of the *Canadian Electrical News* we glean the following particulars regarding his work and career :—

P. W. Sothman, M.I.E.E.,
Chief Engineer, Hydro-Electric Commission of Ontario, Canada.

Mr. P. W. Sothman was born in Haderselv, Denmark, in the year 1870. Though a young man, his experiences have been world-wide, and the recognition of his successful work has been not less so. He has endured his quota of naval training ; he has served his time in the shops, in Hamburg, as the custom in that country is before entering the university ; he has graduated with the E.E. degree from Charlottenburg University, in Berlin ; he has received the degree of Doctor from the Académie Parisiènne ; he has worked several years in the laboratories of the Siemens, Halske Engineering and Manufacturing firm ; he built and operated, as early as 1894, in Grünberg, Silesia, the first really high-tension transmission line, operating at 25,000 volts, the highest voltage thought to be practicable at that time ; he has established and successfully operated large power plants at Johannesburg, South Africa ; he has done similar work at various points in Russia ; he has later, while a director of the Allgemeine Electricitäts Gesellschaft, acted for seven years as general manager and technical director of the power plant and distribution system of Strasburg, extending it to serve 97 municipalities. Finally, he has just witnessed the successful opening of his 283 miles long, 100,000-H.P. capacity, 110,000-volt pressure (still the highest in the world) transmission-line system, with its 11 sub-stations, and soon to serve more than 20 large municipalities and half-a-million people. Four years ago the successful completion of Ontario's Government transmission scheme at this present time could have been utterly foiled by an unwise appointment to the position of chief engineer. The requirements called for able and thorough work, but, above all this, the demand was for a man absolutely impervious to personal or political or financial influences.

Thoroughness has been Mr. Sothman's watchword at every turn, in the location of the line, in the choice of insulators, of towers, of cables and of all other material. To the uninitiated the caution exercised has at times seemed excessive, and even those in closer touch with his work have mildly remonstrated—always, however, with the same result, that the whole work is constructed absolutely according to the ideal of the chief engineer. Without doubt the power-users of Ontario will ultimately recognise the value of this thorough foundation, and the Government congratulate itself on this wise appointment, to which, more than to any other single act, they to-day owe the successful completion of their extensive construction enterprise.

The harmony that exists on the Hydro-Electric flat in the Continental building, is one more splendid proof of the faith of all in their chief engineer. Mr. Sothman has been particularly happy in his choice of assistant engineers, to whom he generously credits much of the success of his first Canadian undertaking.

Mr. Sothman is a member of the I.E.E., the A.I.E.E. and the Canadian Society of Civil Engineers.

Travel and Export Trade.—"Those who in the past claimed to have the best interests of the United States at heart were for ever lamenting the failure to open up foreign markets for our products. Nothing was left unsaid that could be said. Tons of export sermons, good and bad, were scattered broadcast, but the great mass of American manufacturers hustled right along supplying the home market, and doing well at that. The English, Germans and Belgians, however, built up big businesses in countries other than their own. It is interesting to note that the beginnings of the foreign trade of the three peoples named were when the business men thereof began to travel. Not from mass meetings, associations, nor tracts came the impulse, but because they went in person, saw the needs, and instantly wished to supply them. To-day any British sea captain will tell you that in the last half-a-dozen years a fourth has been added to the three classes of globe-trotters he has known—the travelling American. Not the travelling salesman, but the manufacturer who takes his vacation in winter in the West Indies, in South America, or in the Pacific ; or his summer relaxation in Northern Europe, China or Japan. He goes for rest, but comes back full of new ideas, greatly broadened views, and with a desire to have his share of the world's trade. It is to this fact that the growth of the American export trade should and will be attributed."—*India-Rubber World, U.S.A.*

Imperial College of Science.—The London County Council has recently decided to make a maintenance grant of £8,000 to the Imperial College of Science and Technology, South Kensington. In return for this grant it secures the privilege of nominating 25 students for one year's free instruction at the college. These places are to be filled as from October, 1911.

Old Ferrantians' Dinner.—Mr. W. E. Warrilow informs us that the date of this function has been fixed for April 29th. The dinner will take place at the Trocadero, and Mr. C. P. Sparks will occupy the chair. None but old Ferrantians will be present.

Prize Competition.—The Société Industrielle d'Amiens, says *l'Industrie Electrique*, offers a number of gold medals respectively for an improved electrical generator, storage battery, incandescent lamp, fusible cut-out, and bleaching process, as well as a silver medal for a new chemical application of electricity in the Amiens district. Attempts are to be sent to the president of the Society, rue de Noyon, 29, Amiens, before July 1st next.

NOTES ON D.C. THREE-WIRE FAULTS AND THEIR LOCATION.

By WALTER E. ROGERS, A.M.I.E.E.

When one first finds one's self responsible for the maintenance of a three-wire D.C. cable system, and the first symptoms of trouble appear, the very first question is, Where is it? In large towns which have been in operation for many years, the general method of procedure has become standardised and cut-and-dried. This is frequently not so in many of the smaller stations in the provinces, where a small and poorly-paid staff is generally the order of the day. It is with this latter type that I now propose to deal, in the hope that the result of a considerable number of years' experience may assist or prevent some of my juniors from buying their experience at the extravagant price which I paid in my early days. Wherefore, assume one has arrived at the works in answer to the message which said the earth switch dropped at (?) a.m., and there is now a 10-ampere earth on the negative side.

As a first axiom, I say take no man's word for anything connected with cable troubles. Satisfy yourself by actual ocular demonstration that there really is a negative fault on. You inspect the feeder ammeters, but owing to initial economy, the board is equipped with, say, moving iron ammeters of antedeluvian design, *i.e.*, anything but dead-beat. As there are a number of motors on circuit, driving hoists, cranes, chaff-cutters, sausage machines, &c., the majority of the instruments are wagging in a way which makes it impossible to deduce anything.

The shift engineer and switchman agree that there is nothing abnormal in the ammeter readings. A reference to yesterday's log-sheet fails to supply the slightest hint. Nowadays the neutral is never directly earthed, but through a resistance when a fault is on. This resistance frequently takes the form of a bank of incandescent lamps, which, properly arranged, forms as handy and efficient an arrangement as is required. With the assistance of the staff available, one now proceeds to do what is undoubtedly very bad practice—namely, to lift or open the earth switch, *i.e.*, the switch which cuts out the earth-recording ammeter and inserts the lamp resistance. By alternately opening and closing the said switch, the eyes watching the ammeters will generally be able to discover the faulty feeder or feeders; seldom more than two will be affected, even where distances are short and the entire distributing system is interconnected outside, as usually it should be.

Should the feeder ammeters happen to be dead-beat, the ocular test, as above stated, is facilitated. Assuming that we now know the unhealthy section to be fed by feeders A and G, 1 or 7, as the case may be, the next step is to split up the distributors into sections, so that each feeder supplies its own set of distributors, or rather so that A and G each supply a separate and distinct area. This is readily done on a modern system employing feeder pillars, by a man on a bicycle.

With older systems employing more primitive equipments, of course, the isolating process will be a much more lengthy proceeding. In the above I have described a method which is frequently employed, but I have already stated it to be wrong.

It is wrong for this reason—that the earth connection is broken when locating the affected region.

It is unnecessary for me to enlarge upon the very obviously undesirable shocks which this method throws upon everything electrical throughout the installation.

What is admittedly a much sounder proceeding, is to have under normal healthy conditions the works neutral directly connected to earth *via*, of course, the earth-recording ammeter. The earth switch being arranged, as usual, to drop, and so short-circuit or cut out the recorder when the leakage current reaches a certain predetermined value usually limited to the carrying capacity of the instrument. When this switch drops, it should switch in the earth resistance consisting of two banks of lamps in parallel. I say two banks advisedly because one of the banks should have connected in series with it a single-pole switch mounted at some accessible point on the front of the board, whereby the amount of leakage current can be varied by opening and closing this switch without ever actually breaking the earth connection, as was done in the first case described.

By varying the number of lamps in the parallel equipped with the S.P. switch, the leakage current can be controlled and kept as small as possible consistent with producing a just readable deflection on the feeder ammeters.

A variation of the above method which I have seen adopted, will undoubtedly locate the faulty area, but it has nothing to recommend it. It consists in arranging a water resistance in parallel with the earth resistance, and steadily increasing the leakage current till you obtain a large deflection on a feeder ammeter, which will be almost instantly followed by a telephone message to say that the town hall is on fire. Some works have an arrangement whereby a change-over switch is made use of to momentarily flash one or other of the outers to earth, and so to blow a fuse or fuses in the neighbourhood of the trouble. But, like the water resistance above referred to, it is far more likely to create other trouble than assist in eliminating the original fault.

Yet another *modus operandi* consists in commencing by dividing up the system into districts, so that each feeder supplies one district of limited area. Then switch out the feeders in rotation at the generating station, when the disappearance of the leak will quickly indicate the faulty feeder and area. This method, however, is open to the serious objection that supply is interrupted to everbody as the feeders are opened, and therefore it can only be carried out after midnight satisfactorily, if consumers' convenience is to be studied.

There is a method available, however, which avoids all inconvenience and shock to the system, though it involves a small capital expenditure. I refer to an arrangement whereby each feeder can be connected to the bus-bars in rotation through a separate accurate and dead-beat ammeter. This can be readily done where duplicate bus-bars form part of the station equipment. The ammeter, or probably its shunt, is connected to the spare bar, the bar being then paralleled with the working bar on the pole on which the fault has developed.

The feeders are also paralleled on to the spare bar one at a time, then disconnected from the working bar. Current from the negative of the particular feeder which we are now operating upon, will be passing through the test ammeter which readily shows any variation of current leakage due to the manipulation of the S.P. switch in the half earth lamp resistance previously referred to. My previous remark about splitting the area into districts applies equally to what I have just written. Many boards are equipped with switch-fuses on the feeders, used either singly or two in parallel according to local load requirements or fancy. One of these switch-fuses or fuse carriers can readily be adapted to accommodate the necessary connections for the test ammeter, thereby greatly simplifying things.

Turning now to neutral faults, these frequently do not manifest themselves till one of the outers goes to earth also. Then instruments go to the top of the scale, balancers complain, and something has to be burnt clear before pressure becomes stable once more. Not infrequently the presence of a neutral fault or faults will be manifested by the curious line marked on the earth ammeter chart. Quite often an earth showing much like an outer fault will appear, and this earth will change over perhaps several times in the 24 hours. This is especially marked in damp or rainy weather. In tracking this, and, indeed, all faults, the individual's intimate knowledge of his system, generally coupled with a close study of the times when the earth changed character, load on feeders varied, &c., will often enable one to get on the scent of the trouble. But almost always it is a case of leaving the works and getting to work on the distributors, the following being a quick, reliable and simple mode of procedure:—

Procure a board fitted and wired with one, or preferably more batten lampholders and lamps, also a pair of terminals.

Proceed to the affected region, unlink the negative and neutral of one set of distributors, then connect your lamps from the positive live side to the dead side of the neutral. If you are on the faulty cable, current will flow from the +

through the lamps and neutral cable, fault, the earth, and complete the circuit through the station earth plate.

The intelligent reader would have said to himself by now, why use lamps in preference to an ammeter? Well—high-resistance ammeters are somewhat rare birds, unless made for the job. Of course, a series resistance can easily be adapted. But, personally, I strongly object to the use of instruments in the street if they can be avoided.

If the first unlinking does not disclose the faulty cable by lighting the lamps, then "as you were" is the order, and try the next set of distributors, and so on till you find the unhealthy length.

Often, having got the test lamps to light, you can leave them burning in sight whilst you proceed down each road successively which radiates from the point where the lamps are illuminated, unlinking at every available point as you go, till the faulty portion is disconnected, as evidenced by the extinction of the lamps. The reader who has experienced the undesirable result which arises from disconnecting a neutral inadvertently, whilst the outers are alive, will have grasped why I have stated that the negative should also be unlinked. The critic will say that I ought to have unlinked the positive distributor also. This is certainly the safest and soundest practice, for any load there may be on the positive side, is injecting current, so to say, into the faulty neutral cable, even though the latter is unlinked, the current then passing to earth through the fault, and thence to the station *via* the works earth connection. Obviously the above method may be used in the street for tracking down faulty outers, by connecting the faulty side to the sound through the lamps in series, for it must be remembered that it is possible, nay, probable, that there is a considerable percentage of the normal outer P.D. still operating between outers. Having now found our faulty length of cable, we come to the question, What method shall we adopt to find the actual point of mischief? Neglecting the inductive telephone method which has proved very useful on certain A.C. systems, there are only two possible tests to choose between—one, the fall of potential method, and the other the loop test. Personally, I always prefer the latter, as it can be used with equal accuracy to find a short-circuit or a simple earth fault.

There is an almost infinite number of variations of the above tests. Each modification is strongly advocated by certain men, according to their individual experience. Earlier on in this article, when describing the earth connection at the station, I stated that when the earth switch dropped, it cut out the earth ammeter and cut in the earth lamps or other resistance. Perhaps it is better to confine its (the switch's) duty to the first of these actions, and to make the direct connection to earth through a fuse, the earth lamps being connected in parallel with or across the fuse, so that a leak first causes the earth recording ammeter to be cut out, then the fuse blows and the lamps light up.

Summing up, I would say fault-finding as applied to cables is an art in itself. No hard and fast rules can be laid down, as every cable system in every town presents features differing from its neighbour. So far, all my remarks have been confined to earth faults.

I now turn to the remaining types of faults—namely, short circuits and discontinuity, or interruption of copper continuity. The former of these, if it occurs on cables of any carrying capacity, usually makes such a disturbance as to cause failure of supply to consumers, accompanied by their complaints, smoke, noise or the lifting of pavement covers, &c., the location frequently being only too apparent.

However, cases arise where there is nothing to indicate the position of the faults. These must be tested for, using the loop method, as already mentioned; if the short is not also an earth, use and consider one of the defective conductors as earth.

Broadly speaking, there are only two causes of short circuits on street mains—namely, a flooded-out box or a pick point, though a feeder pillar sheared off at the ground by a runaway cart, may be termed a short without greatly violating the technical nomenclature.

Now I turn to the third class of fault, happily the rarest, as it is undoubtedly the most uncertain to locate accurately. I speak of discontinuity of conductor, which, of course, produces failure of supply somewhere. The consumers up to a certain point are O.K. Examine the last O.K. consumers' service connection and the first faulty consumers, this will almost invariably disclose the trouble on a drawn-in system.

Suppose nothing is discovered by inspection. A physically non-continuous cable is not infrequently not accompanied by an earth fault of more than instantaneous or temporary character, so that current cannot be passed through the fault in order to facilitate location by one of the methods already mentioned. Remembering the beautiful comparative method of obtaining the capacity of a condenser, as carried out in the laboratory during your college days, forget all about farads and microfarads. Obtain the most sensitive galvanometer available, which is consistent with use on the site in question; I have successfully used the galvo of a Kelvin testing set. Unlink all three conductors of the diseased distributor on either side of the suspected point of failure.

Say the distance is 100 yd. of ·1 × ·05 × ·1 single conductor cables, the fracture being in one of the outers. Withdraw all consumers' main fuses to ensure that their installations are not on to bother your readings. Proceed to charge the sound length of similar cable through the galvo. and a two-way switch, or, better, a Morse key instead of switch. Having charged the cable, discharge it through the galvo to earth. Note the deflection, say it is 150 divisions; it probably won't be, but I use this figure for demonstration only.

Repeat the process on the troublesome cable, and obtain, say, 75 divisions deflection. The deduction is too obvious to need explanation. Now move your traps to the opposite end of the section of the distributors and repeat the test there. Compare results, and the mean of more than one test should be what you want.

In carrying out this somewhat erratic test, use as high a voltage as is available, say, the live positive outer through an 8-C.P. lamp, and don't, if you can possibly avoid it, use the adjacent tram rail for your earth if the cars are in service at the time.

One point to be particular about is to be sure that your standard length of cable is precisely similar in all respects but length to the faulty piece.

For instance, it is useless to compare the centre of a triple-concentric with the middle conductor or outer.

At times it will be found necessary to bring a piece of cable up from the works to compare with. If this be done it is advisable, but not absolutely necessary, to take it off the drum; also, it is preferable that it should very approximately be of the same length as that to be tested for the failure.

Copper.—Supplies of this metal, as shown by Messrs. Merton's statistical circular, still continue to more than keep pace with the demand. In spite of last year's frequent rumours of intended curtailment of output, we find the tendency is for stocks to increase even their present imposing figures. For the end of March, 1911, the European visible supplies (excluding Holland and Germany) stand at 82,267 tons, or only 120 tons less than for the end of February. English ports have, however, decreased their stocks by 1,988 tons, and French ports 157, the increase on quantities afloat, 2,025 tons, bringing the total round as above indicated. In detailed supplies, we find North America to Europe slightly above average; to English and French ports slightly under. Spain and Portugal are well up, and their total for the month is higher than it has been for two years, viz., 2,574 tons to English ports and 6,030 to the rest of Europe. Shipments from Chili are above average, and from Australia the same. Total deliveries are fairly high, but have been over 40,000 tons since July last, with the exception of February. They considerably exceed previous years. The stock at Rotterdam is shown to have been lowered 300 tons, and that at Hamburg is estimated to have lost 1,000 tons.

It will be interesting to see the American figures for this month, and note if the demand there has increased. For the end of February the stocks were 69,924 tons, an advance of 6,334 tons on the preceding month. The world's supply at that date was, therefore, 152,311 tons, an increase of 5,528 tons on January returns. The American supplies have increased since December; the European are fairly stationary at present, and the world's supplies have increased with the American, though they are now some 27,000 tons lower than the maximum of June 30th last, while the European are 31,000 tons below their maximum of February 28th, 1910.

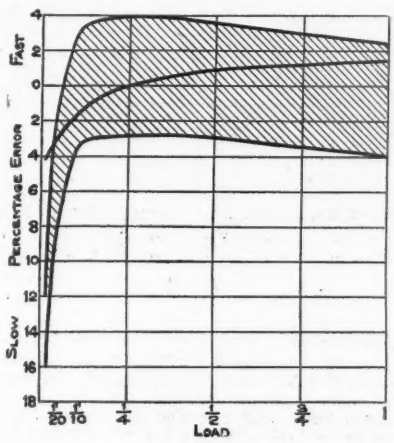
CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Electricity Meters.

In view of the recent discussion in your columns and elsewhere on commutator *v.* mercury motor meters, your readers may be interested in the enclosed diagram.

The shaded band represents the performance of the average mercury meter on consumers' premises, and has been drawn direct from the curve given by Messrs. Ratcliff and Moore in



their recent paper at the Institution. The band is just broad enough to cover the mercury meter's various errors over a variation of only 10° C. from the normal.

The line curve represents the performance of a British commutator meter, which has a negligible temperature error, under the same operating conditions.

R. H. Barbour.

London, S.W., *April 11th*, 1911.

English and German Commerce in the Far East.

It is to be feared that Mr. A. N. Sillar is only speaking the truth in what he writes on page 571 *et seq.* Some time ago, owing to an unexpected series of expenses *en route*, I found myself landed in a South American city with very little ready cash. I was further hampered by the fact that there was no agent, in the place, of my people's bank. I hunted up an English house, and arranged to cable home for remittances to be sent through them. I cabled and waited. Meantime I accepted an invitation of the chief of a big undertaking to go with a party to visit his works, a hundred miles away. No remittance came. The day of departure approached, and I called repeatedly at the English house. At last I put it to them that I was entirely without money, and asked if they would advance £5 so that I could pay my promised visit. I have no complaint to make because they refused this, for I was not introduced to them and was a stranger. The fact that I felt obliged to ask it did, however, tell them how badly I was fixed. Friday came, and my friend asked me if I should be ready to take the yacht journey as arranged. I had to express my regret and call off the acceptance. My friend, however, very kindly enabled me to accept his own invitation. On my return I went at once to inquire about the remittance. An American in the hotel, a stranger to me, supplied the cash for me to cable home urgently. Every day at lunch I sat near to the manager of the English house, who had promised to let me know at once when the cash arrived, and every day we each passed the usual courtesies. Finally I applied to the British Legation for advice. This advice included a request that I would see the English house and tell them I had so applied. So again I called upon them, but was refused a hearing. I insisted, and saw the principal, telling him how very awkward my position was. Much to my astonishment, he said, "I have nothing for you except fifty pounds, which came last Wednesday" (five days previously!). *Then* I began to talk to him, and I told him things which probably he had never been told before in his own office, and I told everyone else too. He had no possible excuse, for, as I have explained, he knew my difficulty. So I took the cash, and another £100 which came later that day, and I went over to the German house of Blohm and deposited it with them, and I had all further remittances through the house of Blohm, both in that and in other towns I went to, and generally had very pleasant business relations with them all the time I was in the country. And when I want to laugh, I think of the principal of that English house as he appeared when I made him listen to the things I told him in plain Anglo-Saxon of the Pennine Range of Lancashire. I hope this is not the way of all our English houses, but it is to be feared it is that of many. Let me chronicle an opposite case. The Dutch West Indisches Mail Co. very kindly lost my principal case of equipment. I saw it put into the hold duly labelled for Trinidad, and I am still waiting for compensation. Let me advise travellers by this Dutch line to insist on receipts for every little item if they do not wish to be similarly treated.

I carried my cash merely as a credit on Blohm's at my next destination, having only enough to see me to that point. The loss of my baggage entailed considerable purchases in Port of Spain. I went to Smith Bros., of the Bonanza Stores, and stated my case, and asked, would they supply me goods on bill payable in London? Smith regarded me a few seconds, and then said, "I'll do it," and he did it, and he did not overcharge me. So here you have one English house to balance another, and let us set the Dutch mail company as a counterblast to the good German house of Blohm.

Viator.

Enclosed Arc v. Metal Lamp.

There is just one point in Mr. P. A. Spalding's letter of April 14th which I am writing about. He gives the current taken by each four-light lantern as 410 watts for 400 C.P. Was this an actual meter reading, or simply based on the maker's catalogue?

I ask this question because, since the National Physical Laboratory took upon itself to test a batch of metal lamps, I notice the makers are not claiming 1 watt per candle for their lamps; in fact, in an advertisement now before me, they claim 1·35 watts per candle (average over 2,000 hours). This is for a lamp quite as good as the one mentioned by Mr. Spalding.

It is therefore quite evident that the claim of less cost for metal lamp lighting as against the enclosed arc cannot be substantiated.

Accurate.

[But the makers *are* claiming one watt per candle for their large lamps.—EDS. E.R.]

A Plea for the Contractor.

I was pleased to see attention being called by Mr. Percy Collins to the serious outlook for electrical contractors if the present and increasing methods of manufacturing and wholesale firms competing against *bona fide* contractors be continued. This unfair competition will have one certain result of the firms in question being boycotted by all contractors as far as ever possible.

There is another very serious and detrimental competition taking place, and gradually but surely increasing, and that is the competitive trading by municipal authorities with contractors. Many such authorities have up to the last few years devoted themselves entirely to the supplying of energy, but latterly they have added to their department an electrical showroom, upon the guarantee that no goods whatever would be sold therefrom, but in many cases I know that the managers of such showrooms not only exhibit apparatus, but actually sell to contractors' customers direct. These electrical departments have been established with the ratepayers' money, and the aggrieved contractors being ratepayers, many to a large extent, it is most unjust that municipal engineers interfere with, and often undersell, ratepaying contractors, who

have their capital invested and do their best to assist such engineers.

Surely it is high time that this unfair competition should terminate, and electrical contractors as a whole expect the Electrical Contractors' Association at once to take steps to ensure its members being protected from such unjust and unfair practices, in which case the contractors must support the Association to the utmost.

A Suffering Contractor.

April 10th, 1911.

Cheap Canadian Power.

Will you allow me the privilege of correcting an item in the ELECTRICAL REVIEW of March 3rd. On page 339 of that number is an item with reference to electric lighting and power at Ottawa, Canada, which is somewhat misleading.

Ottawa's rate of $15 per H.P. is not the cheapest power rate known anywhere, as I will show.

Here in Campbellford, a town about 120 miles from Ottawa, we have a magnificent water-power from the River Trent, owned by the town, and other powers operated by a large company composed principally of English capitalists. The power supplied by the town is sold at $10 and $12, and even lower, and the average revenue for the 1,333 H.P. now in use is not more than $10 per H.P. per year.

Thus you will see that we are at least $5 below the Ottawa rate, and our rate may be classed as the cheapest in the world. We are in a position to supply manufacturers at $9 to $12 per H.P., according to the amount they may require.

J. T. Vosper.

Campbellford, Ontario, *March 30th*, 1911.

PROCEEDINGS OF INSTITUTIONS.

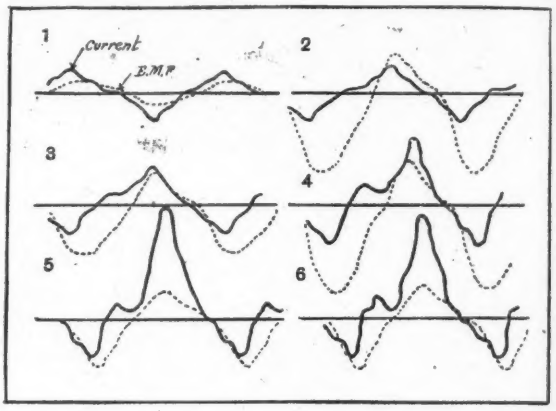
The Faraday Society.

ALUMINIUM-ANODE FILMS.

AT the March meeting of the Faraday Society, held on the 14th ult., MR. G. E. BAIRSTO and MR. R. MERCER contributed a very interesting study of aluminium-anode films, intended as a preliminary account of an exhaustive investigation which the authors are making into the properties of those curious formations. The property possessed by aluminium when it is used as an anode in electrolytic solutions, of forming on its surface a thin strongly-adherent film that offers a very high resistance to the passage of a current in the same direction as that which produced it, is a property of some technical importance, and it is taken advantage of for the construction of rectifiers, condensers and lightning protectors. Such a film will obviously act as a condenser—albeit a leaky one—under the passage of an alternating current, and it was with special reference to the capacity of the films that the present investigation was carried out.

Although previous observers have noticed that the capacity of an aluminium-anode film depends on the maximum voltage used in the formation of the film, faulty methods of measuring the capacities have led to very discordant results in the relationship obtained between these two quantities. The time of formation is also a determining factor that has hitherto been neglected. Messrs. Bairsto and Mercer, using the Sumpner-Record method of measuring the capacity of a leaky condenser (described in the *Journal*, Institution of Electrical Engineers, Vol. 41, page 237), show that the longer the time allowed for the formation of a film, the less will be its capacity, which, however, reaches a minimum value after several days, the period being longer, the higher the formation voltage. The capacity per sq. cm. of surface is almost, but not quite, inversely proportional to the formation voltage. In a particular case, where strong ammonium borate was the electrolyte, the product of the two ranged from 8·1 to 6·9 for a range of voltage from 10 to 119·5.

The capacity measurements throw a good deal of light on the structure of the films. Now, the thicknesses of these films have been determined in two different ways: Directly, by increase of weight, measurement of the coulombs required to form the films, and by interference colours; and indirectly, from capacity measurements, on the assumption of unity (an assumption not, perhaps, justifiable), for the specific inductive capacity of the film material. The two methods give quite different results. Whereas with a formation voltage of 100 indirect measurements result in thicknesses that only vary between $0{\cdot}93 \times 10^{-6}$ cm. and $1{\cdot}13 \times 10^{-6}$ cm., the results of direct measurements depend largely on the electrolyte used, and for the same voltage (100) the figures range from 20×10^{-6} cm. to 170×10^{-6} cm.; enormously greater, it will be observed, than those deduced from capacity measurements. A consideration of these discrepancies convinces the authors that the films are composed of two entirely distinct layers, an inner thin *dielectric* stratum, independent of the electrolyte, enclosed by another, much thicker *conducting* layer, which varies with the electrolyte. The direct method measures the thickness of both



Curve 1.—R.M.S. voltage, 3·5. Curve 2.—R.M.S. voltage, 22·3
„ 3. „ „ 82. „ 4. „ „ 103
„ 5. „ „ 122. „ 6. „ „ 130

FIG. 1.

films; the indirect method, that of the former only. There is good reason to believe that the inner film consists of oxygen in the liquid state, in view of the very high potential gradient that must exist across it, producing enormous mechanical pressures.

The authors have further studied the action of a great many electrolytes whose "valve" action has not hitherto been investigated, measuring the leakage current and resistance at various voltages, and also the critical voltage. This critical voltage is not exactly that at which breakdown occurs, but the voltage at which an *increase* of current takes place over that which flows on first closing the circuit. The new electrolytes investigated were potassium ferrocyanide, potassium ferricyanide, ammonium arsenite and arsenate, and ammonium molybdate. Of these only the molybdate is of any use in building up a high film resistance, and with dilute solutions over 500 volts can be applied without breakdown taking place. The effect of raising the temperature of the cells is to increase the current—that is, decrease the resistance of the film—according to an exponential law.

The influence of impurities in the electrolyte has also been investigated. Generally speaking, salts of acids with high acid-radicals (such as phosphates, molybdates, borates) will allow of much higher voltages being applied to the films than salts of monovalent acids, such as hydrochloric. A mixed electrolyte will usually act like the less efficient constituent from the point of

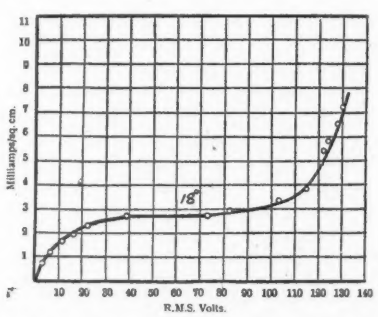


FIG. 2.

view of film resistance. In the case of a phosphate solution, for example, adding potassium chloride or bromide to the extent of one of the impurity anions (Cl or Br) to five of the PO_4 ions, increases the leakage current a thousand-fold.

The experiments made with alternating currents with the object of comparing the efficiencies of various electrolytes for use in electrolytic rectifiers and condensers are of exceptional interest. The current and voltage curves were recorded on an oscillograph, and a large number are reproduced in the paper. It is apparent from these curves that at low voltages the films act practically as condensers; that is, they hardly conduct at all, and the current curves, therefore, lead the E.M.F. curves by about 90° and have equal areas on the positive and negative sides. At higher voltages, when the capacity is small, the current curves become more asymmetrical, and the phase difference between E.M.F. and current diminishes; the films now act as rectifiers. The oscillograph curves obtained show very strikingly the combined effects of the capacity of the film, and of its asymmetrical conductivity. We reproduce in fig. 1 a

typical series of such curves obtained from a solution of ammonium molybdate kept at 18° C. This solution, and that of ammonium borate, were found to be the best electrolytes so far tested.

The corresponding R.M.S. voltage-current curve is also reproduced (fig. 2). It will be seen that the current remains constant over a considerable range of voltage. This is explained by the fact that the capacity of the film decreases as the voltage rises, while the resistance increases. As a result, the effective admittance is practically inversely proportional to the voltage.

It is to be hoped that Messrs. Bairsto and Mercer will continue their investigations on the very obscure, but none the less interesting, phenomena of aluminium-anode films. The subject is well worth pursuing, both from a theoretical and a practical point of view, and we look forward with great interest to the completion of their research.

The Röntgen Society.

An address on the problem of secondary radiation was delivered before the Röntgen Society at the meeting on April 6th by Prof. C. G. Barkla, of King's College. The subject, in its application to medical radiology, was first brought forward a few months ago by Prof. Sir J. J. Thomson, who urged the value in therapeutics of the very soft or easily absorbed rays obtained in this manner. Secondary radiation is that ray emission which comes from the surface of certain metals when they are placed in the path of the primary beam from the X-ray tube. The rays thus obtained are of a character unobtainable in the case of the primary beam, because this very soft radiation is absorbed in the glass of the tube on the way out. Prof. Barkla said that in order to get pure secondary radiation, one must use the radiation proceeding from the surface of incidence, *i.e.*, the metal plate, and that alone. There were three kinds of secondary radiation. The first was a radiation proceeding from air and from light gases, such as carbonic acid gas, nitrous oxide and sulphuretted hydrogen, and was simply scattered. This scattering effect was common to all elements of low atomic weight and compounds containing the lighter elements. Another type of radiation was the corpuscular, equivalent to the beta radiation of radium. All heavy substances exposed to X rays emitted this peculiar quality of radiation, but the distance to which these secondary rays proceeded was very small—1 cm. in air, and perhaps $\frac{1}{1000}$th cm. in water. The most important type of secondary radiation, however, was that to which he gave the name of fluorescent radiation. If one of the heavier gases containing bromine or iodine, or a plate of copper, zinc, lead or iron, were placed in the path of the primary X-ray beam, the effect shown by means of electroscopic leak was greatly increased. The fundamental difference between this secondary radiation and the primary radiation was the almost entire homogeneity of the former and the great lack of it in the case of the latter. To produce this secondary radiation, the essential condition—a law which was also true of the fluorescence of ordinary light—was that the primary beam should be of a more penetrating type than the secondary radiation characteristic of the particular element employed. If a soft radiation from the tube were made to fall upon a lead plate, the lead would give out no radiation. In order to excite that lead radiation it must be exposed to harder rays than those which were characteristic of the secondary stream from lead. Every element had its own characteristic radiation; and, indeed, without much hyperbole, it might be said that every element had its own particular spectrum giving off characteristic lines, only, instead of plotting wave-lengths, it was necessary to plot absorbability. Prof. Barkla worked out the figures for a large number of metals, of which the following few are examples:—

Secondary radiation from	Thickness of aluminium to absorb half.	Thickness of water to absorb half.
Iron...	1/350 centimetre	1/25 centimetre
Selenium	1/75 ,,	1/5·4 ,,
Silver	1/47 ,,	3 ,,
Cerium	1/22 ,,	6 ,,

In therapeutics the particular metal chosen to act as transformer would be selected with due regard to the thickness of the part it was desired that these homogeneous radiations should penetrate. As to the effects in the substance itself, if a great degree of ionisation were required a substance must be employed having heavy atoms. It was useful to remember, added Prof. Barkla, that three factors were in absolute relation—namely, the absorption of the primary beam, the ionisation produced in the absorbing substance, and the secondary radiation which was emitted from that absorbing substance.

The Non-Salient Pole Turbo-Alternator and its Characteristics.

By S. P. Smith, B.Sc.

(*Abstract of paper read before the* Institution of Electrical Engineers *at Birmingham, March 8th*, 1911.)

The advantages of a non-salient pole or cylindrical rotor have induced many of the leading firms to adopt this construction; apart from the mechanical advantages, the shape of the flux curves and pressure waves closely approaches the sine curve, which is generally recognised as by far the best for A.C. working, and remains practically unchanged on load.

Compared with the salient-pole type, the calculation of the flux distribution is a simple matter. The simplest case is taken (fig. 1), in which the slots are uniformly spaced round the periphery, each wound slot containing the same number of conductors, and the air-gap is constant at all points. The ratio of the wound slots to the total number of slots is a very important one, here denoted by β; if all the slots are wound, $\beta = 1$, and the M.M.F. curve is a triangle; if part are left unwound at the poles, the curve is a flat-topped trapezium, and if the winding is concentrated in one slot the curve is rectangular. If no saturation is present in the magnetic circuit, the flux curve is of similar shape to the M.M.F. curve, and the more

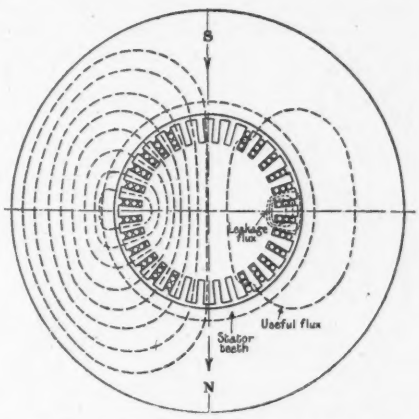


Fig. 1.—Non-Salient Pole Machine; 2-pole rotor, 16 slots per pole—12 wound, four empty.

nearly the latter approaches a sine wave, the more nearly sinusoidal will be the shape of the pressure curve. By plotting the M.M.F. curves for various values of β, it is shown that the more the winding is concentrated, the greater is the flux for a given maximum M.M.F., or, without increasing the size of the machine to provide for greater flux, a given flux can be obtained with fewer ampere-turns. In practice, however, β is seldom made less than 0·6. Assuming that the larger flux could be utilised without disadvantage, the change of β from 1·0 to 0·6 would increase the output by 35 per cent. On the other hand, with constant output, the effect of changing β from 1·0 to 0·6 is to diminish the excitation necessary by 26 per cent., but difficulty arises in accommodating the winding in the slots. As the winding becomes more concentrated, the harmonics increase in value, but over the range of β considered they do not vary much; only the third and fifth are of appreciable importance, their maximum values between $\beta = 0{\cdot}9$ and 0·6 being 10 per cent. for the third, and 5 per cent. for the fifth, in terms of the fundamental in the flux wave. In two and

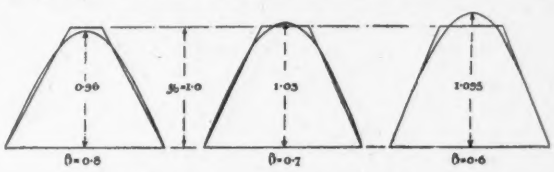


Fig. 2.—M.M.F. Curves for different Values of β, and their Fundamentals.

three-phase machines, the fifth harmonic in the pressure curve ($\beta = 0{\cdot}9$ to 0·6) cannot exceed 1 per cent., and, with all higher harmonics, can be neglected. The third may reach nearly 7 per cent. in a three-phase, and over 3 per cent. in a two-phase machine, but is zero at $\beta = 0{\cdot}66$. The value of β is, therefore, best kept between 0·7 and 0·6, to obtain a sine-wave flux and E.M.F. in a non-saturated machine.

For mechanical reasons, as well as electrical, β should not be less than 0·6, for the lower β, the more concentrated is the winding, and the greater the difficulty of finding room for it in the slots. If wide slots are used, it is more difficult to secure the winding and to obtain the necessary strength in the teeth, and tooth ripples become troublesome. Cooling is also hindered, the heating being more concentrated and the ventilation less effective. It is more difficult, too, to ensure perfect balance.

The reduction of β, it is true, is accompanied by a reduction in the ampere-turns necessary to obtain a given flux; thus if $\beta = 0{\cdot}9$ instead of 1·0, 91 per cent. of the ampere-turns suffice, and 90 per cent. of winding space is available; with $\beta = 0{\cdot}8$, the excitation required is 84·5 per cent., to be accommodated in 80 per cent. of the space, and with $\beta = 0{\cdot}7$, 78·5 per cent. excitation in 70 per cent. of the space. Beyond that the saving diminishes, and difficulties arise with the design. Hence, from all points of view, the best results are obtained with β between 0·85 and 0·65.

In order to obtain good regulation it is necessary to work on the flat part of the magnetisation curve, with the rotor teeth saturated. But as the output of the machine is, in general, determined by the output of the rotor, and saturation implies increased excitation loss, the higher the saturation the less will be the output of the machine for a given rotor and excitation loss. Hence for fine regulation the machine must be large for its output, or the temperature rise higher, or the ventilation be improved. If good

regulation is not so important, or if an automatic regulator is used, the output of the machine can be increased.

The effect of saturation on the wave shape cannot be discussed quite generally; but in a given example it is shown that saturation tends to flatten the wave.

The calculation of the characteristics of a non-salient-pole type of alternator is easy. There is very little leakage, and what there is tends to smooth the corners of the M.M.F. trapezium, making it more nearly sinusoidal. In the paper the process of determining the magnetisation curve is detailed, and the method of graphically constructing the flux curves is described. These curves are then analysed, and it is shown that only the third harmonic is of importance, being negative at low magnetisations and becoming positive as the saturation is increased. At normal saturation values this harmonic is negligible, both in the flux and in the pressure waves, and thus the production of a sinusoidal pressure curve under all no-load conditions is a characteristic of all non-salient-pole turbo-alternators.

The open-circuit characteristic can be calculated in various ways, some of which are illustrated. The armature reaction M.M.F. is practically sinusoidally distributed, and it is shown that in non-salient-pole alternators the resultant flux curve is not distorted, as in salient-pole machines; the M.M.F. curves being sine waves, and the reluctance of the magnetic path constant for all positions of the flux, when load comes on the flux curve is simply displaced in position without change of shape. Hence the shape of the pressure wave is unaffected by the nature of the load.

The non-salient-pole type of alternator readily lends itself to standardisation, the rotor diameters being graded and the length of the rotor given various values according to requirements. It is noticeable that the size of the machine must be considerably increased for a given output if the regulation is improved; for example, a given machine will give the following outputs for the regulations named:—

Regulation, per cent.	9·5,	15·0,	21·0,	28·0,	35·0.
Output, K.V.A. ...	740,	935,	1,070,	1,135,	1,200.

Discussion.

Mr. A. M. Taylor: The author showed that with 15 per cent. regulation a given machine would give 935 K.V.A., and with 28 per cent. 1,135 K.V.A., demonstrating how much cheaper it was to put in a machine having a poor regulation for a given K.V.A. output. The reduction of the short-circuit current was the pretext for introducing the poor regulation. Taking the second of the two outputs quoted, the drop from no load to full load would apparently be, in the case of a 5,000-volt machine, from 5,000 to 3,900 volts. If, instead of the full-load current, they had a short-circuit current of ten times this amount, a terminal voltage of zero would be reached (given sufficient time) before the short-circuit current had attained to the dimensions of 4½ times the full-load current. No doubt such a drop in voltage would not actually occur, as the eddy currents induced in the rotor would prevent the wiping out of the rotor flux; considering, however, that there would be twice the number of demagnetising ampere-turns in the stator that were necessary to reduce the rotor field to zero, it seemed to him highly probable that the reduction in the rotor flux would be of the order of from 50 to 70 per cent. Such a drop, supposing the short circuit to occur between the generating station and one of the sub-stations, might be sufficient to throw the rotaries at the sub-station out of step, as these would be converted into generators discharging into a circuit of extremely small resistance. It seemed desirable, therefore, that before engineers agreed to sacrifice all regulation in the generators at the main station, they ought to be assured that in doing so they were not incurring the risk of throwing the synchronous machinery at the sub-station out of step.

Dr. M. Kahn pointed out that they were indebted to Charles Brown for the type of rotor in question. A very serious consideration in the design of these rotors was the selection of the correct value β for the ratio of the wound to the unwound portion of the rotor circumference. In the case of two-pole machines a value of β of 0·7 to 0·8 would probably be found to give the most economical designs. In four-pole machines a smaller value might often be found sufficient to accommodate the rotor winding. These values also gave M.M.F. curves nearest to sine waves. The influence of the regulation on the size of the alternator was not sufficiently shown by the figures given; the difference in output would be considerably greater.

Mr. N. Pensabene-Perez said that the author, in his desire to decompose the field curve into its harmonics, had been obliged to assume a very simple trapezium curve, neglecting the M.M.F. steps, the saturation of the iron and the reluctance of the slots. To his mind, the graphical method in which it was possible to trace the shape of the flux curve by taking into consideration the above-mentioned elements was much more accurate and simple. The effect of slot reluctance on the E.M.F. wave form was very important in turbo-alternators, where the slots were generally larger than the teeth. He had compared two machines of the axial slot type built by the Electric Construction Co., one fitted with phosphor-bronze wedges to keep the winding in the slots, and the other fitted with steel wedges. While a larger third harmonic was present in the first-mentioned machine, an almost sinusoidal curve was obtained in the other type. Deep steel wedges were most desirable in turbo-alternators, because they did away with sudden changes of flux density in the flux curve, so that no sudden drop of E.M.F. took place between coils in the adjacent armature slots. Also this practice tended to increase the rotor leakage, and permitted of higher saturation being reached. The armature leakage was also increased, but this was a very welcome element in turbo-alternators, in which short-circuit currents might reach enormous magnitude. In his opinion the real advantage of the non-salient pole type was purely mechanical, and electrical in so far as it would be possible with such construction to push much further the losses in the field winding, as the cooling of the distributed winding was much more effective, taking place principally by conduction to the iron mass.

Mr. H. W. Taylor said he had applied analytical methods similar to those used in the paper to a special form of the non-salient-pole machine, and had had very satisfactory results. But although the method might be sound, many of the conclusions stated by the author as of general application to the non-salient-pole type of machine should only be applied to the particular type dealt with by him, and were not justified when used with reference to some of the other forms of construction which were being used by various firms. In modern machines it had become a matter of importance that the reactance should assume a reasonable figure. He was surprised to see a machine suggested with a regulation of 15 per cent. or even 20 per cent. at 80 per cent. power factor. Makers of machines had for some time been trying to get central station engineers to adopt a machine with coarse regulation and to have the voltage maintained constant within a small percentage by means of an automatic regulator. Even without a regulator, hand control of the voltage was quite easy, even with a coarse regulation between full and no load. He was afraid that the scheme of standardisation outlined by the author would not be found so simple as might at first sight appear.

Mr. Smith, in reply, said that with one exception, viz., Dr. Kahn, all the speakers had entirely failed to grasp the spirit of the paper; it was not his intention to compare this type of rotor with the well-known salient-pole type, nor to advocate its use. Thus, the discussion of the regulation was quite irrelevant; he merely introduced it in its logical order for the sake of completeness. Neither was it his intention to advocate a machine with close regulation rather than with coarse. It was true that the simple trapezium curve which had been assumed necessitated neglecting the effect of the slots, as pointed out in the paper. That this small simplification, however, should make the whole investigation unreliable was absurd, as the slots in a case like that in fig. 1 had very little effect on the main shape of the flux or the E.M.F. wave, and in most modern designs magnetic wedges were used for closing the slots to avoid the prominence of any tooth ripple. Beyond this the investigation was just as accurate as that of any other engineering problem. That the method adopted in the present paper could not be applied to every type of non-salient-pole machine had been pointed out in the paper itself.

Wireless Telegraph Working in Relation to Interferences and Perturbations.

By J. E. Taylor, A.M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *London, April 6th*, 1911.)

The working efficiency of a radio-telegraph installation is very greatly influenced by its freedom or otherwise from interferences and perturbations of all kinds. Considerations of immunity from avoidable disturbances have, therefore, a very important aspect in the matter of selection of suitable sites and in the general design and lay-out of stations, especially those intended for coast station traffic with ships at sea. The character of the receiving apparatus used also demands consideration in the choice of site, since receivers of the auditive type have now, because of their undoubted superiority for the purposes of coast station work, almost entirely replaced those of the recording type. The receiving range of a station using auditive receivers is practically limited only by the inability of the operator to interpret signals of less than a certain strength in the telephone receiver, and almost absolute silence in the building in which the apparatus is housed is very necessary.

Interference by local inductive disturbance is avoidable. It is necessary to ensure that there is no electrical disturbance of the radio-telegraph receiver by the operation of the land circuits. Such disturbance may, in the case of Morse apparatus on the land circuit, arise from sparking at relay and key contacts, electrostatic or electromagnetic induction from circuit leads, or from battery leakage direct or *via* the earthing elements, and direct induction from the external line to the aerial wires of the radio-telegraph plant. To obviate these troubles, telegraph or telephone circuits are led into the station by a short length of underground cable, so that the exposed landline is at least 30 or 40 yards distant from any part of the aerial wire system of the radio-telegraph plant. The landline apparatus and wiring are located in the operating room as remote from the radio-telegraph apparatus as possible, consistent with convenience in having both sets of apparatus manipulated by one officer. Twin wiring is adopted for the connections of the apparatus and batteries (if any), and a visual and noiseless call in the shape of a small telephone exchange glow lamp is provided. The land-circuit earth connection should be made separately to an earth-plate distinct, and separated by at least a few yards, from the main high-frequency earthing system of the wireless telegraph plant.

In addition to inductive disturbance of the wireless telegraph receiver by the landline there is also the reverse action to consider, viz., the powerful electrostatic induction of the wireless transmitting plant on the landline and Morse apparatus. In the case of wireless telegraph transmitters with coupled or closed-circuit excitation, troubles of this kind are not very apt to occur;

but if "plain aerial" transmission, or any form of transmission involving pre-charging of the aerial system prior to disruptive discharge across the spark-gap be used, strong inductive disturbances are liable to be created on neighbouring circuits.

Methods of transmission involving pre-charged aerials are banned in the British Postal Telegraph Service except as purely temporary expedients, by reason of their emission of waves of a character very prone to produce interference with other wireless stations. In postal telegraph practice the wiring of the low-frequency apparatus is effected throughout with lead-screened cable. This is found effective in preventing sparking due to electrostatic induction, whilst further aiding in reducing the effects of "back surges."

Complete isolation of running machinery from the operating-room, preferably by locating it in a separate structure, is desirable to eliminate vibration effects, and battery-charging circuits should be excluded completely from the operating-room.

The consideration of mutual disturbance produced by radio-telegraph stations on one another opens up a peculiarly involved problem. The theoretical investigation of the possibilties of selective signalling from contiguous stations by the use of wave-lengths differing sufficiently from one another, presents no insurmountable difficulties, but its practical realisation is quite another matter. In certain tracts of sea around the British Islands where congested radio-telegraph conditions arise, it is, unfortunately, sometimes necessary, under present working arrangements, to rely largely on "shouting down" interfering stations. Although, under the International Radio-telegraph Convention, the range of wave-lengths allotted for ship to shore working is strictly limited and defined, no radical improvement in working conditions can at present be expected from any system of allotting distinctive wave-lengths for individual coast stations. Many of the manipulative difficulties at present experienced in radio-telegraph working would, however, be largely reduced if less disturbing and more speedy types of transmitters were adopted at certain Continental stations. Much benefit would likewise accrue from the adoption of a standard method of easily and readily regulating the strength of antenna current to suit the particular communication on hand, such as by a regulating coupling between the closed circuit and the aerial circuit in coupled transmitters.

Stations in sufficiently close contiguity are liable to powerful electrostatic induction across from aerial to aerial, tending to produce forced oscillations, the effect of which on the receiver it is extremely difficult to annul. This effect decreases very rapidly with increase of distance of separation. It is more pronounced in transmitters of the open-circuit type, in which the aerial system is charged up to a high potential prior to discharge across the spark-gap. The pre-charged aerial method produces an extensive and obtrusive electrostatic field, whilst the electrostatic field produced by the coupled transmitter is negligible in comparison, and can be made wholly unobtrusive in its interference-producing qualities. One well-known system in which the pre-charged aerial method is usually adopted, is the Lodge-Muirhead. Excellent as are the results which have been obtained with this system, practice has shown that it is not advisable to attempt to work a Lodge-Muirhead and an ordinary coupled transmitter station using earth in too close proximity, or the result will be disastrous for the latter.

Emphasis must be placed on the disability of the station experiencing such interference at close quarters to "tune out" to the necessary extent by dissonance, assuming coupling methods and receiving appliances of the kind required for the efficient operation of a spark system.

Interference by pre-charged aerials on distant stations is also of a very pronounced character; this effect cannot, of course, be due to electrostatic induction, but is doubtless determined by the impure character of the waves emitted.

Heavily coupled transmitters give rise to interference both in respect of impurity of wave-train, due to forcing at the transmitter, and in respect of the well-known double wave emission. In this category many of the continuous wave and even the quenched-spark transmitters must be placed, unless they be connected in such a way as to reduce damping in the aerial system to a sufficiently small amount by reducing the radiation coefficient of the aerial.

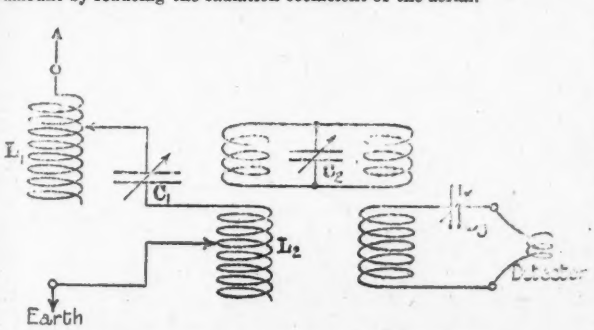


Fig. 1.—Scheme of Marconi Multiple Tuner.

Lightly coupled spark transmitters have most certainly proved themselves to occupy a premier position as regards elimination of objectionable interference. With a sufficiently light coupling, great purity of wave form is attainable and a high degree of selectiveness assured. For ship-and-shore communication, a very light coupling is impracticable, both by reason of the diminution of range and because, if sharp tuning is necessary, there will be a difficulty in getting into touch; calls would be lost, and the communication would lose its utility. There is, however, no good reason why all installations for coast and ship communications work should not be provided with "stand-by" and "tune" adjustments, not only for the receivers, but for the transmitters. If such a scheme were universally adopted, the "stand-by" sides of the apparatus being used only for calling and look-out purposes, and the "tune" sides for actual transmission and reception of messages, a very great improvement might be looked for in the conditions of working to ships at sea so far as the British and Continental seaboards are concerned. Under present conditions of operating coast station services, there are periods during which the "jamming" of the signals of one station by others is so pronounced that confusion begets confusion, and "shouting down" becomes the order of the day.

Regulation of interference at the receiver is a very important proposition. It is unfortunate that complete elemination of disturbance by regulation of the receiving appliances is not feasible, as in that case the difficulties experienced in successfully legislating for the regulation of transmitters would not arise. The connections of the well-known Marconi "multiple tuner" in simplified diagram form are shown in fig. 1.

Primarily, the object of this instrument is to make use of variable coupling while providing an intermediate circuit of very small damping. The end achieved by the use of the intermediate circuit, so far as interference reduction is concerned, is to enable the maximum benefit to be derived from the reduction of coupling. Without its use, since both the detector and aerial circuits possess considerable damping coefficients, it would not be feasible to reduce the coupling to so great an extent and still preserve signals of readable strength. In the diagram, L_1 is the variable aerial inductance; C_1 is the variable aerial condenser with thin high-quality ebonite dielectric; L_2 is a supplementary inductance coil in series

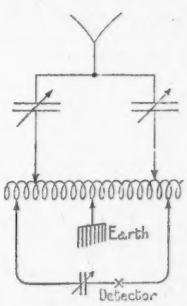


Fig. 2.—"Bridge" Scheme of Interference Preventer.

inductively coupled to No. 1 inductance spiral of the intermediate tuning circuit; C_2 is the intermediate circuit tuning condenser similar in type and construction to C_1; whilst C_3 is the variable condenser for tuning the detector circuits. Both windings of the intermediate tuning circuit are mounted on a common spindle so as to be capable of rotation through an angle of 90°, serving to vary their couplings with the respective fixed windings simultaneously from a maximum down to zero. The values of the windings, type and gauge and insulated wire, sizes of spirals and ranges of condensers adopted in the construction, have been determined by careful experiment with a view to producing the most effective results over the range of wave-lengths to which the tuner is adjustable. It is, of course, specially designed to suit the standard Marconi magnetic detector. The instrument is fitted with a switch for cutting in or out the intermediate tuning circuit and coupling adjustment. When the tuning circuit is cut out, the inductance spiral L_2 is replaced by the detector winding, the connections being transferred from the detector circuit by the operation of the switch. In this way one position of the switch places the detector coils directly in the aerial circuit in series with the adjustable inductance and condenser, whilst the other position brings the special tuning circuit and coupling adjustment into operation. The two positions of the switch are known as the "stand-by" and "tune" positions. Rough tuning only is afforded on the "stand-by" side so that the detector is sufficiently responsive over a large range of wave-lengths to transmitters of ordinary adjustment. On the "tune" side a sufficiently reduced coupling determines sharp tuning and a high degree of selectivity so that disturbing waves of slightly different length can be eliminated or sufficiently reduced unless of much greater strength than those to which the instrument is adjusted.

In contrast with coupling methods of reducing interference, various plans of divided circuits have been proposed or used in which the impulses conveyed by one branch are annulled by those conveyed by the other, except to the extent necessary for the interpretation of the signals required. In these methods the required signals are "tuned in" as against tuning out undesirable impulses. Fessenden's "differential" method and S. G. Brown's "bridge" method are examples of this class. The basis of the bridge scheme is shown in diagram, fig. 2.

If the two branches of the divided circuit are absolutely symmetrical, all received impulses will divide equally and no effect will be produced on the detector (which occupies a position corresponding to the galvanometer in a Wheatstone Bridge). A very slight disturbance of the balance by shifting the point of the earth-wire connection to right or left will determine signals on the detector from the branch best tuned to the received impulses. If these impulses consist of a sufficiently long train of waves, discrimination is effected between these and any other impulses (even if of the

same periodicity) if such other impulses are of a more rapidly damped character. A "valve receiver" interference preventer based on a similar principle has been patented by Marconi.

It is not abundantly clear that devices of this kind possess advantages over, or involve any further principle than, that of reduced coupling. Greater promise of satisfactory elimination of disturbances and perturbations is afforded, in the writer's view, by the adoption of non-earthed directive aerials, at any rate, so far as the shorter waves in practical use are concerned. For communication over short distances between fixed stations, simple balanced directive aerials disposed to radiate in the line of communication give promise of very satisfactory results. These take the form of a vertical triangle, the apparatus being connected in circuit at the midway point of the base line, no earth connection being used. The properties of such aerials have been very fully investigated by Bellini and Tosi and confirmed by Post Office investigations. Such a system is responsive only over a very limited range of wave-lengths, determined mainly by the length of base line. This should be as large a fraction of the wave-length used as may be practicable. Post Office tests have shown that very powerful long-wave stations may be freely operated at comparatively short distances away without producing the least disturbance on such a system, quite irrespective of directional properties. Provided the directive system is, in itself, accurately balanced with regard to neighbouring conductors—such as stay-wires to masts, &c.—and is arranged with its mean plane of propagation at right angles to the line joining it to the disturbing station, powerful stations may be operated at close quarters without interference, irrespective of wave-length used. By making the best use of these properties and combining them with well-tuned transmitters and receivers, quite a remarkable degree of immunity from disturbance by neighbouring stations or atmospheric electrical perturbation can be secured.

Transmitters of high sparking rates or intermittency, producing a constant musical note in the receiver, lend themselves to acoustical methods of reducing interference both by reason of the possibility of resonating acoustically to the spark frequency and by the comparative ease with which signals of high and constant periodicity can be magnified at the receiving station. This method appears to have been fully worked out by the Telefunken Co., but the plan has not yet been put to trial in the British telegraph service.

The phenomena known in operating parlance as "X's," otherwise parasitic impulses or "atmospherics," present a wide variety of characteristics depending upon the latitude in which they are observed, the season of the year and the time of day. They manifest themselves in the auditive wireless receiver as a series of scraping, scratching or explosive noises of various intensities. Less frequently they render themselves evident by variable fizzing or frying noises in the receiver. They present distinct periodic characteristics in all latitudes, being stronger, more persistent and prevalent during the summer than the winter months, whilst they also present distinct periodic variation connected with the times of rising and setting of the sun, though varying very greatly in intensity and prevalence from day to day at all times of the year. This relation to the hours of daylight and darkness is analogous to that of the diurnal variations of terrestrial magnetism, whilst also the phenomenon is closely assimilated with certain forms of earth-current disturbances perceptible, owing to their rapidly varying character, on earthed telephone lines.

During thundery weather, atmospheric impulses are always very pronounced, and occasionally cripple the working of the coast stations in this country for several hours together or even, in exceptional cases, for a whole day. In the winter months, in this country, these disturbances are rarely strong enough to interfere seriously with traffic, whilst they are sometimes totally absent for days together. The writer arranged for a series of observations to be taken simultaneously at all the coast stations in this country during the week commencing December 11th, 1910.

The results obtained show that these disturbances affected practically the whole of the British islands, though they did not, apparently, possess the same characteristics of intensity at all places simultaneously Concurrently with a period of heavy disturbance, a gale of considerable force sprang up and wrecked the wireless mast at the Isle of Wight (Niton) coast station.

With regard to means of reducing interference due to "atmospherics," no special devices are at present in use at the British coast stations, and it is problematical whether any entirely effective arrangement is possible, for the reason that a rough, comprehensive kind of tuning adjustment is essential at these stations for their normal receiving arrangement or "stand-by" adjustment, in order that calls on a variety of wave-lengths from ships may not be missed. For actual reception of messages, however, the sharply tuned adjustment with variable coupling can be resorted to, and the intensity of disturbance thereby much diminished. Tuning alone does not appear to be by any means a complete solution of the problem, doubtless for the reason that most, if not all, of the disturbing impulses have no specific wave-length or frequency of their own. They appear to be due to sudden changes in the electrical state of the atmosphere (probably in the higher regions), which determine sudden changes in the electrical charges normally induced on the aerial wires. The sudden release or accumulation of a charge will set the aerial system into electrical oscillation at the latter's own periodicity. Hence the futility of tuning them out. That they are reduced by tuning and weak coupling to a greater extent than signalled impulses is doubtless due to the damping factor of the aerial system, which determines a rapid rate of decay and few oscillations for the individual disturbance, whilst the signalled impulses may consist of much longer trains of oscillations.

Wireless "freak" communications are wrapped up in the phenomenon of variations in the transmitting efficiency of the atmosphere. Perturbances in this respect exhibit almost the same characteristics of irregularity as atmospheric impulses. Freak ranges of communication or variations in range of communication occasionally occur by day, but the variations noticed during the night hours are much more pronounced. The sudden veiling or obscuring of distant signals together with the equally sudden "opening out" of signals observed whilst listening on the receiver at a wireless station during the prevalence of this phenomenon is very impressive. These variations of range are not found to synchronise definitely with the periods of atmospheric disturbances, though it may well be that more disturbances are observed when the range extends. The author has, however, observed these remarkable variations in range on nights when "atmospherics" have been conspicuously absent.

LEGAL.

LONDON ELECTRIC SUPPLY CORPORATION, LTD., *v.* WESTMINSTER ELECTRIC SUPPLY CORPORATION, LTD.

Judgment.

ON Saturday, April 8th, Mr. Justice Joyce, in the Chancery Division of the High Courts of Justice, delivered his reserved judgment in this action, which was brought to restrain an alleged breach of an agreement entered into between the two companies. The case was argued by Mr. Gore Brown, K.C., and Mr. Austin Cartmell on behalf of the plaintiffs; and Mr. Younger, K.C., and Mr. W. S. Kennedy for the defendants; and the hearing was concluded on March 8th.

In giving judgment, his LORDSHIP said that both companies were duly authorised to supply electrical energy in, amongst other places, the borough of Westminster, and to some extent their powers were concurrent and competing, though the plaintiffs practically supplied only alternating current and the defendants continuous current. Alternating current was supposed to be better for lighting purposes, while continuous current was more suitable for power. After a certain time, as was well known, the local authorities would be empowered to purchase the undertakings, and in the plaintiffs' case the earliest date would be 1931. In that state of things, on May 4th, 1910, the two companies entered into an agreement, which was duly sanctioned by the Board of Trade. That agreement, which was made under the provisions of the London Electric Supply Act, of 1908, was very elaborate and complicated, but it was well considered and carefully prepared, and no doubt each party had the best legal advice and assistance. Putting it broadly, the effect of the agreement was that the defendant company took over for its own benefit the working of the plaintiff company's undertaking in the Westminster area so far as was allowed by law until such time as it should be purchased by the local authority. The consideration was a fixed annual payment of about £22,000, and certain other arrangements. One of the terms was, in substance, that on the purchase by the local authority the plaintiff company should receive the price of their undertaking notwithstanding the agreement, and if the price was less than £100,000 the defendant company were to make up to the plaintiff company the difference. Clause 11 of the agreement provided that the defendant company should fulfil all conditions and requirements in respect of the supply of electrical energy to which the plaintiff company was, or might become, subject within the Westminster area, and should indemnify the plaintiff company in respect of all claims against them by reason of any default in such supply, provided that such default did not arise from the default or neglect of the plaintiffs. Upon the sanction of the agreement by the Board of Trade the plaintiff company handed over to the defendant company their undertaking, and the defendant company assumed its management and working. The claim in the action was twofold. The plaintiff company first asked for an injunction to restrain the defendant company from soliciting or attempting to induce any consumer in the Westminster area who now took, or might hereafter take, the plaintiff company's alternating current, to cease to take it, and in lieu thereof take the defendant company's continuous or direct current. The plaintiffs' contention was that the defendant company, as managers of the plaintiff company's undertaking, were in a fiduciary position to them, and bound to prefer the plaintiffs' interests to their own. In his (the Judge's) opinion that claim was founded on an entire misconception of the relations between the two companies. The defendant company were entitled, subject to their statutory obligations and to fulfilling the specific stipulations of the agreement, to work the plaintiff company's undertaking for their own benefit. The defendant company, broadly speaking, purchased, as far as the law would allow, the right to work and take the profits for themselves of the plaintiff company's undertaking in the Westminster area, managing it in their own interests entirely. That was in substance the object and intention of the whole arrangement. The plaintiffs' second contention was that the defendant company was precluded by the agreement from doing anything directly or indirectly to reduce or diminish the requirements of the plaintiff company's consumers for alternating current. He was of opinion that such a contention could not be supported, and he held that as a matter of fact that the defendant company had not really done anything intended or calculated to induce any consumer

in the area who at the date of the agreement took the plaintiff company's alternating current, to cease or discontinue doing so, or to induce any such consumers to take the defendants' continuous current instead. The plaintiffs had asked for a declaration according to the true construction of the agreement, that the defendant company, not as between themselves and the public, but as between the two companies, was bound to supply electrical energy by means of the plaintiff company's alternating current to any consumer in the Westminster area who might apply to the plaintiff company for a supply of electric energy by means of alternating current. He came to the conclusion that this part of the claim also was not established. The whole action accordingly failed, and must be dismissed, with costs.

Cruse *v.* Willans & Robinson, Ltd.

According to the *Manchester Evening News*, judgment was given on 12th inst. in the Official Referee's room at the London Law Courts in the action in which Mr. Henry Cruse, trading as the Cruse Controllable Superheater Co., and Ernest Grether & Co., carrying on business at Salford, claimed from Messrs. Willans and Robinson, of Rugby, £10,000 for alleged breach of contract, and Messrs. Willans & Robinson had counterclaimed for £1,900.

"The hearing of this action, which was begun in Manchester last October by Mr. Edward Pollock, High Court Official Referee, and continued by him at the London Law Courts, occupied 55 days, and has involved, it is said, a total expenditure of about £20,000. Mr. Pollock has heard during the evidence 60 witnesses, including experts of high standing. One witness alone was in the box for nine days. The plaintiffs had alleged breach of contract in respect to the manufacture of superheaters to be attached to boilers, which were estimated to save from 15 to 20 per cent. on coal consumption. The defendants' case was that these were manufactured from faulty designs."

In giving judgment, "Mr. Pollock reviewed the facts of the case at great length. He said it had been alleged on behalf of the plaintiffs that the defendants knew that the superheaters were to be manufactured to fill the contracts made by the plaintiffs, and that some of them were not up to contract through negligence on the part of the defendants in execution. They claimed damages in respect of repair and examination and consequential damage as to the result of the goods not complying with the contract. The defendants said if there were any defects they were due solely to the design of these superheaters, and they counterclaimed for the balance of the price of the superheaters delivered and the price of the rejected ones, as well as for dies they manufactured in order to carry out the work. It appeared to him (the Official Referee) that the question was, if there were any defects, whether these defects were due, as alleged by the defendants, to faulty design, or were they due, as alleged by the plaintiffs, to defects in the material and workmanship? Mr. Pollock said he had sufficient evidence to justify him in the conclusion that these superheaters did not fail by reason of any defective design, but they had failed entirely through the bad work put in. He awarded the plaintiffs general and special damages amounting in all to £3,535, and also gave judgment in their favour on the counterclaim. Plaintiffs would also have the costs of the claim and counterclaim. He added there were special grounds which justified him in making an order for costs on the High Court scale."

Uxbridge and District Electric Supply Co., Ltd.

A petition by the above company, and the liquidator, came before Mr. Justice Swinfen Eady in the Chancery Division, on Tuesday, April 11th, to sanction a scheme of arrangement.

Mr. Peterson, K.C., explained that the scheme provided for the payment in full of the shareholders and unsecured creditors of the company. A new company was to be formed, and the shareholders would retain one-fifth of the shares they held, and the remaining four-fifths would be transferred to Messrs. Callenders' brokers, who would guarantee the principal and interest of the new company. There was to be an issue of £75,000 of stock by the new company, and the creditors would receive 20s. in the £.

There was no opposition to the scheme, and his Lordship sanctioned the arrangement.

Arc Lamps, Ltd.

In the Companies' Winding-up Court, Chancery Division, on Tuesday, April 11th, Mr. Justice Swinfen Eady had before him the petition of Siemens Bros. Dynamo Works, Ltd., for the compulsory winding up of Arc Lamps, Ltd.

Mr. Edwards appeared, and said he was instructed to withdraw the petition, having received no notice of support.

His Lordship accordingly dismissed the petition, without costs.

Bradford Electricity Supply.—Although the exact figures of the output of electricity during the year just closed will not be known for some time, it is estimated that the figure of 20,000,000 units will be reached for the first time in the history of the electricity department. For the first time since 1902 the general supply output has exceeded the amount required for the running of the tramways.

BUSINESS NOTES.

Anchor Hospital Fund.—We have received from the hon. secretary (Mr. A. Crooke) of the Hospital and Distress Fund, which is in operation at the Anchor Cable Works, Leigh, Lancs., some information regarding the working of the fund during the year. The first annual meeting, which was held on the evening of April 5th, was informed that all of the workpeople, also the staff, are members, a fact which has put the fund upon a sound basis. The secretary reported upon the useful work that had been done, and the prospects for greater success in the future. Grants were made to Leigh and Manchester Infirmaries, the Southport Convalescent Home, and the Pretoria Pit Disaster Fund, and allowances were also made to help certain necessitous members over temporary difficulties. There was a balance of £59 in hand, out of which further grants of £47 were made. Mr. James O. Callender is president of the fund.

Metallic-filament Lamps: Continental Agreement.—A Berlin report announces from circles associated with the manufacture of metallic-filament lamps that an agreement has been arrived at between the A.E.G., the General Electric Co., and the German Incandescent Gas Light (Auer) Co., whereby the companies agree to mutually respect their patents for wire lamps. Negotiations for the conclusion of a general convention for metallic-filament lamps, as has existed for a long time past in the case of carbon-filament lamps, are not taking place at the present time. Nevertheless, it is not out of the question that arrangements of the above kind may be extended later on, and be developed into a general convention. As to the prices of wire lamps in Germany, it is mentioned that certain arrangements already exist, although they are not strictly binding. After the A.E.G. made large reductions in 1910, the remaining makers of metallic-filament lamps in Germany and Austria met and resolved to adopt the same level of prices as the A.E.G. At the present time the German business in wire lamps is rather quiet, and the factories are producing largely for stock. This state of affairs is, however, a seasonal event, which is manifested between April and June every year.

Glow Lamp Manufacture in Japan.—It is reported from Buda-Pesth that the United Glow Lamp and Electricity Co., of that city, has been requested by the Japanese Government to erect a glow lamp factory in Japan. The company will shortly send an engineer to Japan in order to examine the conditions for the purpose.

"The Salesman's Creed."—Some good advice for managers of businesses and salesmen is given under this title on a card issued by the St. Helens Rubber and Cable Co., Ltd., of Warrington. Copies will be forwarded on application.

Catalogues and Lists.—Messrs. Gillespie & Beales, Amberley House, Norfolk Street, Strand, W.C.—Illustrated circular describing, and giving diagrams explaining, the "Alva" induction type wattmeters. Prices are tabulated.

Messrs. Ercole Marelli & Co., 26, Garlick Hill, London, E.C.—Leaflet relating to a new type of swivel and trunnion desk and bracket oscillating fan; also a pamphlet, giving illustrations, prices, sketches and particulars of their small motors for direct or alternating current.

The British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park.—Well illustrated brochure of 36 pages (No. 1,435/1), containing full descriptive particulars of their Westinghouse impulse type steam turbines, with half-tone blocks showing parts, also line diagrams; an additional 12-page inset is devoted exclusively to good half-tone pictures of a number of typical installations. After a full introduction regarding principles, there are sections dealing separately with high-pressure turbines, low-pressure turbines, mixed pressure turbines, back pressure and reducing turbines, and small turbines. Curves of tests, a list of customers, and a map showing the location of the Westinghouse turbines in Great Britain, are given. Any reader can obtain a copy of this publication by sending his business card.

The Wardle Engineering Co., Ltd., 196, Deansgate, Manchester.—Two leaflets relating respectively to the "Barrow" suspension device, and the "Onelite" reflector fitting.

The Union Electric Co., Ltd., Park Street, Southwark, London, S.E.—New illustrated list (No. 1,021) containing description, prices, code-words, shipping particulars, &c., of their friction hoists for D.C. or A.C. for loads from 5 to 45 cwts. These hoists have been designed for use in building construction, and the range of sizes covers most ordinary requirements.

Messrs. Betts & Betts, New York.—General Bulletin No. 61, illustrating their colour caps for electric lamps for signs, some effective results in large signs being shown; also Flasher Bulletin No. 62, illustrating and particularising their "Noark Pickup" electric flasher signs.

The British Thomson-Houston Co., Ltd., Rugby.—The following new lists in the company's now thoroughly familiar style, containing descriptions, prices, dimensions and illustrations of the manufactures mentioned have recently been issued:—No. 280, devoted to float electric switches, single or double-pole type; No. 281, is concerned with automatic hoisting winches for lamps, tools and small machines requiring a fixed hanging position; No. 282 relating to high torque A.C. watt-hour meter (type EH) house service pattern; No. 283, dealing with pressure governors; No. 284, with Radiator lamps; No. 285, with automatic starting compensators for induction motors with squirrel-cage rotors;

No. 286 describes automatic starting rheostats for continuous-current non-reversing motors above 15 H.P., and No. 287 contains particulars of oil-immersed switches for induction motors.

Messrs. Brown & Co., 73 to 85, McAlpine Street, Glasgow.—Illustrated booklet showing views of their various departments at Waterloo Saw Mills where they manufacture all kinds of woodwork, including showcases, boxes, and so forth, for electricians.

Allgemeine Elektricitats-Gesellschaft, Friedrich-Karl-Ufer 2-4, Berlin N.W.—Pamphlets relating to their starting transformers and switches, switch pillars and electrically-driven planing machines.

Representation in Sweden.—H.M. Consul at Stockholm reports that an Englishman there, who has been resident in Sweden for 15 years and has travelled extensively in that country, desires to represent British manufacturers of electrical plant and material, especially in connection with the generation of hydro-electric power for mills, &c. His name and address may be obtained by British firms on application to the Commercial Intelligence Branch of the Board of Trade in London.

Book Notices.—*Elementary Aeronautics.* By A. P. Thurston, B.Sc. London: Whittaker & Co. 1911. Price 3s. 6d. net.—In this book the author aims to give the reader a simple and concise account of the action of air upon moving planes, propellers, &c. As late engineer to Sir Hiram Maxim, and lecturer in aeronautics at the East London College, the author has become a specialist in this subject, and his teachings possess the weight derived from personal experience; he has, moreover, carried out a number of interesting and original experiments on stream-line flow, with the aid of jets of smoke, the photographs of which greatly assist the reader in forming correct ideas regarding the peculiar and characteristic motions of air about stationary objects immersed in it, the flow of air about propellers, and so on. The author deals with the theory, design and construction of flying machines, and gives numerous drawings and half-tone illustrations of actual machines by well-known makers, as well as of the petrol engines by which they are driven. The book should prove both interesting and useful to all who are in any way concerned with aviation, but the title is very misleading, for the contents are almost wholly confined to that subject, whereas "aeronautics" essentially includes balloons and airships and the wide range of problems connected with them within its scope.

The Marconigraph is the title of a new monthly publication which is now being issued by the Marconi companies, "to acquaint the lay reader with the latest possibilities in connection with" the Marconi system of wireless telegraphy. The first number contains a half-tone portrait and biographical sketch of Mr. Marconi, and a variety of notes and short articles, an abridged report of the recent trial in which the Marconi patent of 1900 was upheld, and news items, the whole forming a very creditable issue.

Protection of Plant and Lines Against Surges.—A book issued recently by Messrs. Isenthal & Co., of 85, Mortimer Street, London, W., is something more than a catalogue, though it includes lists and prices of the apparatus described. It embodies a treatise on the "Theory of Surges," dealing with the precautions that must be taken to prevent surges in cable networks, the methods of coping with them when they occur, lightning strokes and their effects, the mode of production of surges, and the means available for protecting high and low-pressure A.C. and D.C. circuits from injury. The system advocated is that employing the Moscicki condensers and the Giles valve, which have been fully described in our pages. The information given is very detailed and comprehensive, including all classes of installations, and examples of the application of the system to existing stations of large size are given. We understand that the devices described have recently been in extensive demand for South Africa, Australia, China, and Japan.

"The National Physical Laboratory: Report for the year 1910, and Collected Researches, Vol. VII, 1911."—The latter contains papers on "Magnetic Disturbances at Kew," and "Results Obtained with an Elster and Geitel Electrical Dissipation Apparatus," by Dr. C. Chree; "The Use of Mutual Inductometers," by Albert Campbell; "Comparative Life Tests on Glow Lamps," by C. C. Paterson; and other subjects, not of an electrical nature.

We notice that in the issue of "Work" for April 8th, a series of articles on "Simply Made Apparatus for Wireless Telegraphy" was commenced.

"The Post Office Electrical Engineers' Journal." Vol. 4, Part 1. April, 1911. London: H. Alabaster, Gatehouse & Co. Price 1s. net.

"Il Nuovo Cimento." January, 1911. Pisa: Stabilimento Tipografio Toscano.

"*Transactions* of the Illuminating Engineering Society." Vol. VI, No. 3. March, 1911. Easton, Pa: The Society. Price 75 cents.

"Isteresi del ferro nei cicli asimmetrici di magnetizzazione alternativa." By G. Vallauri. Extract from the *Atti* della Associazione Elettrotecnica Italiana. Milan: From the author.

"The *Journal* of the American Society of Mechanical Engineers." April, 1911. Price $1. Baltimore, Md.: The Society.

"*Journal* of the Franklin Institute." Vol. CLXXI, No. 4. April, 1911. Philadelphia: The Institute.

"Atti della Associazione Elettrotecnica Italiana." March, 1911. Milan: Stucchi, Ceretti e C.

"Annales des Postes, Télégraphes et Téléphones," and "Mémoires de MM. Pupin et Campbell sur la Propagation des Courants Telephoniques." March, 1911. Paris: A. Dumas. Price 6 fr.

"The Motor-Boat Manual." London: Temple Press, Ltd. Price 1s. 6d. net.

"Garcke's Manual of Electrical Undertakings and Directory of Officials, 1911." London: Electrical Press, Ltd. Price 21s. net.

"La Technique de la Houille Blanche et des Transports d'Energie Electrique." By Etienne Pacoret. 1911. Paris: H. Dunod & E. Pinat. Two vols. Price 55 fr.

"*Transactions* of the South African Institute of Electrical Engineers." Vol. I, Part 14, and Vol. II, Part I. 1911. Johannesburg: The Institute. Price 2s. each part.

Mr. Leo. Meycliar, author of the "English-Russian and Russian-English Engineering Dictionary," published by Messrs. E. & F. N. Spon, Ltd., has been awarded a silver medal at the recent Exhibition of Publications held in St. Petersburg under the auspices of the Russian League for the Renovation of the Fleet.

Bankruptcy Proceedings.—A. D. Poulter, printer and electrical engineer, Surbiton.—First and final dividend of 5s. 6d. in the £, payable April 25th, at 132, York Road, Westminster Bridge Road, S.E.

Walter William Crawford, consulting engineer, 22, Henrietta Street, Covent Garden, W.C., and Cumberland House, Kew.—Under a receiving order the debtor attended for public examination last week, before Mr. Registrar Giffard, at the London Bankruptcy Court. The statement of affairs showed total liabilities £21,221, of which £4,779 is expected to rank against net assets valued at £1,148. In the course of his evidence, the debtor stated that he came to London in January 7th, 1904, and commenced to practise as an engineer at Northumberland Avenue, W.C., removing in March, 1905, to Covent Garden. When he came to London he had a capital of about £200, and only owed one debt—to a firm of engineers who had now proved for £1,189 in respect of a judgment debt, interest and costs. Witness in his statement of affairs returned Messrs. Johnson & Phillips as creditors for £750. They obtained judgment against him in the early part of 1910, and consented to accept £850 in satisfaction of their claim. He had since paid them £100 on account. The firm were manufacturers of electrical machinery, and at the time of the judgment witness was in Australia acting as their agent. The debt was in respect of a contract for the lighting of Port Adelaide, which contract was sent to him under the conditions of his agency. The contract was, however, signed in witness's name, as he had not at that date received power of attorney from his firm. That was not the first lot of machinery he had supplied through Messrs. Johnson and Phillips. In regard to payment, he was usually given a 90 days' bill. Witness accepted the bills, and obtained the money from the person to whom he supplied the goods. The firm, however, did not deliver the machines until nine months after the order was given. Consequently, there were penalties attached to it. Witness attributed his failure to bad debts and to losses incurred in connection with various companies in which he had been interested. The examination was concluded.

E. F. Jones, plumber and electrical engineer, 132, York Road, West Hartlepool.—May 1st is the last day for the receipt of proofs for intended dividend. Trustee, Mr. J. S. Brittain, North-Eastern Bank Chambers, Stockton-on-Tees.

Dissolutions and Liquidations.—Rosario Electric Co., Ltd.—Creditors must send particulars of their debts, &c., to Mr. H. E. Benthall, 52, Moorgate Street, London, E.C., the liquidator, by May 30th.

The *Review of the River Plate* states that La Radiante Electric Light Co., of Bolivia, has gone into liquidation; the works had never gone ahead for want of funds.

The Power Publishing Co., Ltd.—This company is winding-up voluntarily, with Mr. E. W. Sanger, 6, Bouverie Street, E.C., as liquidator.

Trade Announcements.—Mr. Jose M. Rodrigues Pereira, who is already carrying on business as an electrician and mechanical engineer at Belem do Pará, Brazil, is shortly opening another house at Rio de Janeiro with several electrical, mechanical and hydraulic engineers, under the style of Rodrigues Pereira & Co., his provisional address, whence price lists and discounts may be sent, being Rua Ferreira Vianna, No. 22, Rio de Janeiro.

The Century Electric Co., of St. Louis, whose A.C. motor list was alluded to in a recent issue, are represented in the United Kingdom and the British Colonies by the Adnil Electric Co., Ltd., of Artillery Lane, London, E.C., as sole agents.

Messrs. Donovan & Co. removed last week from Barwick Street to larger and more convenient premises at 47, Cornwall Street, Birmingham, where they will carry a much larger range of stocks of conduits and fittings, so as to deal expeditiously with this class of trade, they having started a conduits [and fittings department, of which they are making a special feature. Two telephones (Nos. 5703 and 5704) have been installed.

Metallic-Filament Lamps.—Reduction in Price.—An important announcement is being issued this week by the leading makers of metallic-filament lamps, which should have an appreciable influence upon the future use of lamps of large candle-power for the lighting of streets and open spaces, as well as of shops, large rooms, &c. The demand for these in the early stages of their development was naturally small, and consequently their manufacture was to a great extent experimental and costly, compared with that of the lamps of ordinary sizes, of which millions have been made. Their suitability for the purposes mentioned above, however, was quickly appreciated, and the demand, stimulated by the proved efficiency and long life of the lamps, has rapidly increased during the three years or so that they have been on the market.

The natural result has been to enable the makers to cheapen the cost of production, without detriment to the excellent qualities of

the lamps, and by common consent they have agreed to reduce the prices to the values given in our advertisement columns to-day. The General Electric Co., Ltd., offer a range of 100, 200, 400 and 600-watt Osram lamps, at 100 to 260 volts, and consuming about 1 watt per candle, at prices from 4s. 9d. to 20s. each. We are informed that hundreds of thousands of these lamps have already been sold, and that they are replacing arc and gas lamps for street lighting in many towns—in Torquay eighty 1,000-c.p. Osrams are in use. In Hammersmith the Borough Council has installed a large number of Osrams for street lighting, and officially records an average life of over 3,600 hours, several lasting over 8,000 hours, and 19 out of 75 over 5,000 hours. Tests made by the National Physical Laboratory on 100-volt 16-c.p. Osrams show an average life of at least 2,000 hours, the test only being carried up to that point, with an efficiency averaged throughout their life of 1·29 watts per candle, but the larger lamps run at about 1 watt per candle.

Messrs. Siemens Brothers Dynamo Works, Ltd., Dalston, have correspondingly reduced the prices of their 200 and 400-c.p. "Onewatt" lamps in all voltages, their 100-c.p. lamp remaining unchanged at 4s. 6d.

Messrs. G. M. Boddy & Co., of Gray's Inn Road, who for the past 15 years have played a prominent part in the sale of incandescent lamps, have reduced their prices to the same scale as the Osram lamps.

It should be clearly understood that there is nothing in the shape of a "price war" in these reductions; they are the outcome of increased sales and the resulting economy in cost of production.

LIGHTING and POWER NOTES.

Aberdeenshire.—Dunecht House, the Scottish residence of Lord Cowdray, is being fitted with electric lighting. A power house, battery room and workshops are to be erected. Mr. W. D. Ironside, of Aberdeen, is in charge of the work.

Aldershot.—The U.D.C. has decided to apply to the L.G.B. for sanction to a loan of £2,500 for extensions of plant at the electricity works and to provide a new battery.

Altrincham.—A L.G.B. inquiry has been held into the District Council's application for sanction to borrow £6,150. It is proposed to erect an electrical generating station. At present the supply is obtained from the Trafford Power and Lighting Co., who desire to terminate the agreement.

Barnsley.—The T.C. has decided to extend the electricity works at a cost of £16,100; £8,300 for plant, £6,700 for mains and services and street lighting, and £1,100 for lamps and fittings. It was stated that the undertaking had proved very successful, and that the extensions were absolutely needed. The revenue last year was £963 more, and the additional plant will bring about a lower production cost, and it is expected it will enable the Corporation to make a bigger grant in relief of the rates. The whole of the present street lighting will be supplanted by electric lighting which will afford a better light at a cheaper cost.

Bognor.—The U.D.C. has asked the Pier Co. to submit terms for lighting the Parade by electricity.

Mr. V. G. Lironi, of Southsea, has informed the Council that a company is being formed to acquire the electricity station erected by Mr. W. Tate, and to promote a Bill in Parliament for the supply of electricity to the district. He suggests that he should discuss with the Council the insertion of a purchase clause in the Bill. The Council has referred the matter to the Lighting Committee.

Bolivia.—On the authority of the German Consul, there would appear to be a good opportunity for installing an electric lighting plant at Riveralta, as the population of that town has doubled during the last three years, and is still rapidly increasing. At present oil lamps and candles are mainly used by the inhabitants.—*Board of Trade Journal.*

Bolton.—The Watch Committee has requested the Electricity Committee to allow the electrical engineer (Mr. A. A. Day) to report upon the electrical installations at the Theatre Royal, Grand Theatre, and the Hippodrome.

Boston.—Mr. Chas. Pullan, of Bradford, has approached the T.C. with reference to an E.L. scheme for the borough, and inquired whether the Corporation will oppose a company seeking powers to lay down an installation. The Council has taken no action in the matter.

Burnley.—It has been decided to reduce the lighting charge from 3¼d. to 3d. per unit less 5 per cent. discount for cash within 21 days. The traction supply will be at 1·20d. per unit, as compared with 1·25d. last year.

Bradford-on-Avon.—At a recent meeting of the U.D.C. the lighting of the town was discussed, gas being the present illuminant. A member referred to the steps other towns are taking in the matter of electric lighting, and suggested that inquiries should be made with the view, if possible, of having an installation for Bradford. It was agreed to request the Lighting Committee to make such inquiries.

Cardiff.—The Council has decided to install a rotary converter at the Hayes sub-station, in order to meet the increased load in the centre of the city, and the electrical engineer has been instructed to ask for tenders.

Chatham.—The T.C. has decided to have an experimental 2,000-c.p. arc lamp placed in the Town Hall for a week, with the view of having the building lit by this means. The Kent Electric Power Co. offer to supply the lamp for £10 15s., and to provide current, and maintain it, for £3 per quarter.

Continental Notes.—Holland.—An electric light and power station for the province of Groningen is proposed. One plan, providing for a central station at the town of Groningen, would entail an expenditure of some £104,000. Of the tramways projected in the province, all of which, with the exception of the line from Groningen to Drachten, are to be of narrow gauge, the line from Groningen to Zuidbrock will be the first to be electrified, and the electrification may be continued to Wildervank.—*Board of Trade Journal.*

Germany.—The Government of Baden has refused the application of the firms Brown, Boveri & Co., the "Motor" A.G., of Baden, and the Schlettstadt Elektrizitätswerke to erect a water power station near Schwörstadt, on the ground that the Railway Administration may require to erect a station there for the generation of electricity to work the railways; and, secondly, because doubts exist as to the advisability of sanctioning further power stations on the Upper Rhine so long as those at Laufenburg (45,000-h.p. capacity), and Augst-Wyhlen (30,000-h.p. capacity), still find difficulties in disposing of current in Baden. There is, in addition, the projected station at Kembs of a capacity of about 45,000 h.p.—*Zeitschrift für Turbinenwesen.*

Croydon.—The B.C. has resolved to oppose the Metropolitan District Railway Bill and the London Electric Railway Bill. If passed in their present form, said Alderman Miller, they would seriously affect the Council's interests.

Cuba.—A Canadian company has received a concession for the erection of an electric light and power station at Cienfuegos. Twelve months are allowed for the carrying out of the work. Further particulars of the B. of T., 73, Basinghall Street, E.C.

Darwen.—The General Purposes Committee has decided to supply electric current for power purposes to customers taking not less than 5,000 units per quarter at a flat rate of ¾d. per unit net, and that gas for power purposes be supplied at 2s. per 1,000 cb. ft.

Dublin.—Mr. P. C. Cowan, Chief Inspector of the L.G.B., will hold an inquiry in the City Hall, on the 24th inst., into the application for the loan of £128,129 towards the carrying out of the electric lighting extensions in the city and suburbs. Our correspondent gives it as the general opinion that in a comparatively short time the proposed extensions and the plant will not be sufficient for the demands for electric lighting and power, and that the true solution of the problem would be found in the building of a new central generating station rather than expending any further money on the Pigeon House station.

Ealing.—The T.C., on April 6th, decided not to fall in with the suggestion of Mr. H. R. Hooper, L.G.B. Inspector, that the cost of meters and house connections should be met out revenue or the reserve fund instead of making it part of a loan the Council wishes to keep the reserve fund for the provision additional generating plant. A sum of £5,000 has been applied for meters.

Eastbourne.—On Sunday last almost the whole of the town was in darkness from 11 o'clock p.m. until about 1.30 a.m. on Monday through a failure of the electric light. In the hotels packed with visitors, the majority of whom had not retired for the night, the excitement was considerable.

East Kent.—The *London Gazette* for April 11th contains full notice of the application to Parliament for certain powers of the Kent Electric Power Co. to a new company.

Glasgow.—Work is now well advanced in connection with the construction of the aerial railway, which will form one of the attractions at the forthcoming National Exhibition here. The track is 130 ft. in height, and its whole length will be 2,000 ft. The motive power will be electricity, a live wire providing current to a 10-h.p. electric motor, with chain gear separately driving all the four wheels from which the carriages are suspended.

Golborne.—The B. of T. has deferred for a year the question of revoking the E.L. order, 1905. The U.D.C. has under consideration the taking of a supply in bulk.

Haslingden.—A L.G.B. inquiry was held here on the 12th inst. into the T.C.'s application to borrow £8,750 for purposes of distributing and supplying electricity, the current being taken from the Accrington Corporation. It was pointed out that at present Accrington was supplying Haslingden with current, cars and men for its tramway system. The agreement would terminate in December, 1912, and Haslingden would then supply current to the cars from its own distributing station. When this occurred the undertaking is expected to show a small profit.

Hornsey.—A boiler capable of evaporating 12,000 lb. of water per hour will have to be provided to cope with next winter's demand. There will also be required two further coal bunkers

The estimated cost of the boiler, together with the pipes, floor plating, valves, steel flues, &c., two steel bunkers and their erection, the extension of the Temperley transporter, and one feed pump is put at £3,500, while the cost of the necessary extension to the buildings will be £600. The Electricity Committee, in addition to the foregoing, reports that further extensions of buildings may be required with a view to the installation of additional plant during the summer of next year, and the estimated cost of these extensions of buildings is £5,450. Application is to be made to the L.G.B. for sanction to borrow £9,600.

King's Lynn.—The T.C. has decided to reduce the price of current for ordinary lighting from 4½d. to 4d. per unit as from September 30th next.

Kingswood.—The Electric Supply Co. having applied for permission to place overhead lines in the district for the transmission of energy, the U.D.C. has replied that at present it does not see its way to accede to the request.

London.—St. Pancras.—The Electricity Committee reports having received and considered a report from the chief electrical engineer, stating that for some time past the day load had increased to a point which has rendered it necessary to have both the generating stations in operation all day; if the whole of the load during, say, 10 hours of the day, could be taken on to the King's Road station, it could be dealt with by the turbine there, which only requires about 17 lb. of steam per KW., and this would show a clear saving of about 10 lb. of steam per KW. over the present method. To effect this it will be necessary to lay three-phase mains between the two stations. With a view to keeping the expenditure to a minimum at the present time, the chief engineer suggested that only one main should be put in now, but that a four-main capacity duct should be laid, so that additional mains could be drawn in as required in the future; he estimates the cost at £3,100, including the necessary additions to the switchboards, and assuming this to be a capital charge, and allowing for repayment and interest at, say, 8 per cent., there would be a saving of £1,300 per annum, after allowing for loss of current in transmission and between the two stations. In addition to this estimated saving of £1,300 per annum, a further saving in wear and tear would follow, also the economy in oil, &c. The proposals of the chief electrical engineer are to be carried out.

Deptford.—The Works Committee of the B.C. has had under consideration the desirability of the authority undertaking the reinstatement of openings made in the roads and footways of the borough by companies and persons having statutory rights to make such openings, instead of permitting them, according to the present practice, to reinstate such openings themselves, and has decided to give the system a year's trial from October 1st next.

Madagascar.—The abundant water resources which Madagascar possesses are an asset which should assist toward the industrial development of France's latest colonial acquisition. The tendency in this direction is illustrated by the application just made by M. A. Caplong for permission to build an hydraulic station on the River Ranomaloto, in the district of Antakara. The current generated is to be used for the working of a gold mine.—*Revue pratique de l'Electricité.*

Motherwell.—Damage estimated to amount to £800 was caused by fire in the storerooms at the burgh electricity works in Hamilton Street. The building contained valuable electrical fittings and other goods. The cause of the fire is a mystery.

New Zealand.—The Waihi G.M. Co.'s water-power scheme, at the Horahora rapids, Waikato River, which is being carried out under the supervision of Mr. F. Black, consulting engineer, Wellington, will include six Boving 1,500-H.P. turbines, operating on a 24-ft. head, and coupled to 5,000-volt three-phase generators. A 48-mile duplicate transmission at 50,000 volts, which crosses the coast range at an altitude of 2,400 ft., runs to the mine where it is proposed to apply electric power to the new pumping plant for sinking purposes, air compressors, workshops and subsidiary surface machinery, and at the start to one winding engine, which may be followed by others.

Prestbury and Leckhampton.—The Cheltenham T.C. has applied to the R.D.C. for consent to supply electricity in these parishes.

Rawtenstall.—At the L.G.B. inquiry on the 11th inst. for sanction to borrow £15,000 for electricity purposes, it was stated that the capital expenditure up to the end of March under electricity account was £37,671, and the amount sanctioned, £33,800. The excess amount spent in cables was £2,261. The Corporation had arranged to supply the Haslingden Workhouse with alternating current, and also Bacup Corporation in bulk with H.T. alternating current, and negotiations were in progress with Rochdale Corporation to supply it with current for running 2½ miles of tramways in the Bacup area.

Salford.—The T.C. has engaged Sir A. B. W. Kennedy, at a fee of 200 guineas with travelling expenses, to investigate and report upon the scheme for the alteration of the generating plant at the Frederick Road works.

Stafford.—On the recommendation of the Gas and Electricity Committee, the Corporation has decided to allow tradesmen free supplies of gas and electricity for Coronation illuminations, provided that the fitting up of the premises is carried out by the department.

Stockton-on-Tees.—The T.C. has decided to supply energy to Messrs. Head, Wrightson & Co., Ltd., on a five years' agreement, at 1¼d. per unit for the first two years, and ¼d. per unit for the remaining three years, with a minimum annual payment of £500. The capital cost entailed will be £5,000, and of this sum £3,700 will be spent this year.

Stourport.—The B. of T. having inquired as to what steps are being taken to carry out the E.L. order, the U.D.C. has replied that it does not desire the order to be revoked.

Stretford.—The Electricity Committee, acting upon a report of a sub-committee, has decided that it will not at present consider the acquisition of additional plant. Estimates are to be obtained for an alteration of the battery to enable it to be utilised with both the traction and lighting boosters.

Swansea.—The E.L. Committee of the T.C. has decided to install the E.L. in the slaughterhouses and cattle market, and to charge the Market Committee 4½d. per unit for current.

Swindon.—The T.C. has decided to supply current at 2d. per unit to wiring contractors for use in the display, for sale, of illumination devices for the Coronation celebrations.

A loan of £3,510 for a new battery has been applied for by the T.C.

Truro.—The T.C. has been in communication with Messrs. J. B. Saunders & Co., Ltd., with reference to an E.L. scheme for the borough, and the matter is in the hands of the General Purposes Committee. Mr. F. Swarbrick has also approached the T.C. with an electric light scheme.

Watford.—The U.D.C. has decided to have the remaining 550 public lamps converted to electric lighting during the year.

For Coronation illuminations current will be supplied at 2d. per per 8-C.P. lamp, with a charge of 5s. for connecting and disconnecting.

Wimbledon.—A Sub-Committee appointed to consider alternative routes for electric lighting cables from Wimbledon to the Maldens and Coombe district, submitted three alternative schemes, the cost being respectively £3,719, £3,241 and £7,459. The borough electrical engineer is to be directed to ascertain what demand for current there is likely to be from residents in that part of New Malden adjacent to Malden Station and the Malden Police Station, and report the result. A draft agreement has been approved as to a supply of energy to be given to the sewage pumping station and works of the Merton Council in West Barnes Lane.

Yeovil.—Messrs. J. and W. Purves, of Exeter, having decided not to proceed with their application for a prov. order for E.L., have asked the T.C. if it is willing to support an E.L. scheme to be carried out under an agreement with the Corporation. The Council has decided not to enter into such an agreement.

TRAMWAY and RAILWAY NOTES.

Belfast.—The annual report of the tramways manager shows that for the year ending March 31st, 1911, the total revenue amounts to £218,300, an increase of £14,426. The working expenses amount to £112,959, an increase of £5,624; this leaves a working profit of £105,341, an increase of £3,802. The net revenue charges, including interest on debt, the annual fixed payment of £8,962 to the general purposes fund, income-tax and other smaller items, amount to £51,291. The net revenue (or disposable profit) amounts to £54,051, being an increase of £7,755. "I venture to submit," continues Mr. Nance, "that it is a very gratifying fact that this commercial undertaking of the Corporation is able to show a profit, over and above every expense which could be lawfully charged against it, of this material amount. The figure would be £9,000 higher were it not for the obligation to make an annual contribution of that amount to the general purposes fund as a fixed charge." The disposal of the net revenue balance is appropriated as follows:—Sinking fund, £24,625: depreciation fund, £13,000; statutory reserve fund, £16,730; general purposes fund, £295; total, £54,051. The receipts per c.m. (at 10·22d.) have materially increased by ·57d. per c.m. run, though it is not so satisfactory, continues the report, to find that the working expenses (at 5·29d.) have also increased by ·21d. per car-mile run. The buildings, depôts, cars and machinery have been maintained, and are in perfect repair and in the highest state of efficiency. Passengers carried, 49,485,091; car-miles run, 5,129,698: average fare paid per passenger, 1·03d.; average number of passengers per car-mile, 9·64; units used per car-mile, 1·28; total units charged for during the year 1910-11, 7,679,037 units; used for traction purposes, 6,582,032 units.

Birkenhead.—At the T.C. meeting on the 12th inst., Alderman Oldham, in submitting the estimates for the ensuing year, stated that the Tramways Committee, in place of applying for rate assistance to the extent of £1,000, hoped to be able to pay its way and make a contribution of £1,143 to the renewals fund. The reserves of the undertaking stood at £12,069 in March, 1910, which, with a capital outlay of £366,000, gave a percentage of 3½ per cent.

Bradford.—Renewals of track have been decided upon which will involve a total expenditure of £6,734.

The Tramways Committee has decided to apply to the B. of T. for sanction to double a portion of the track on the Lidget Green section.

The Committee has also agreed to allow the Coronation Decorations Sub-Committee to decorate tramway poles on the route of the local procession, and has decided that two decorated and illuminated cars be run over the various sections during the Coronation festivities in the city.

Bury.—A driver and conductor in the employ of the Bury Tramways Department were summoned by the police on 12th inst., at the Rochdale Police Court, for not bringing their tramcar to a stand immediately before reaching a certain point in Drake Street, as required by the by-laws. Defendants were represented by Mr. Robinson, of the Rochdale Town Clerk's Office, who, admitting that a technical offence had been committed, asked for leniency. Each defendant was ordered to pay a fine of 1s. and 4s. costs.

Continental Notes.—Denmark.—It is reported from Copenhagen that a syndicate of Danish, Swedish and British financiers are interesting themselves in a scheme for the construction of an electric railway between Randers and Aarhus.

Germany.—The A.E.G., of Berlin, has secured a preliminary concession from the Government of Saxony in respect of a projected electric railway been Mittweida and Burgstadt, a distance of about 16 miles, for the transport of both passengers and goods.

Glasgow.—The two-stage fare system which has been experimented with on the tramways has given rise to a considerable number of complaints from passengers and others, and at the last meeting of the Corporation the attention of the convener of the responsible Committee was drawn to the second portions of tickets, which were in as good condition as could be expected, being refused by conductors; that passengers with such tickets had been ejected from the cars because they failed to pay their fares a second time; and he was asked if such action was in accordance with the instructions of the Committee. Bailie Russell, in reply, said that difficulty had arisen because of passengers presenting tickets for the second stage which would hardly hold together. The public were beginning to realise that these tickets had to be kept in a presentable condition, and he thought the trouble was now at an end.

For about a year the motormen and conductors with employés in other sections of the T.C. tramways service have been agitating for better conditions. The motormen and conductors claimed a 48-hours week instead of a 54, with a fortnight's holiday with pay in place of five days (with pay) as at present. The general manager, in a report, pointed out that to grant motormen and conductors a 48-hours week would mean an increased annual expenditure of £28,000, while to grant the increased holiday would involve a further increase in expenditure of £5,500. The Sub-Committee of the T.C., which has considered the matter, now recommends the application of the motormen and conductors be not entertained, but that in lieu thereof their wages be increased as follows:—Men under 1 year, 4s. 2d. to 4s. 3d. per day; men under 1½ years, from 4s. 4d. to 4s. 5d. per day; men under 2 years, from 4s. 6d. to 4s. 7d. per day; men under 2½ years, from 4s. 8d. to 4s. 9d. per day; men under 3 years, from 4s. 10d. to 4s. 11d. per day; men under 4 years, from 5s. to 5s. 1d. per day; men under 5 years, from 5s. 2d. to 5s. 3d. per day; men under 6 years and upwards, from 5s. 4d. to 5s. 5d. per day; men over 5 years (conductors who have not qualified as motormen), from 5s. to 5s. 1d. per day. Increases to certain employés in other branches of the service are proposed, the whole amounting to £8,203, made up as follows: Car works—handymen and labourers, £834 5s. 6d.; Pinkston Power Station—labourers, £18 4d.; depôt fitters, £111 3s.; motormen and conductors, £3,121 6s.; permanent way—dressers, £28 12s.; labourers, £2,905 18s. 8d.; depôt staff—cleaners, sandmen, and greasers, £824 4s.; cranemen, £5 10s. 6d.; bodymakers, £165 15s.; coach painters, £187 17s.

The recommendations will be considered by the parent Committee, when a deputation from the employés will be present.

London.—Lewisham.—The B.C. has decided to request the L.C.C. to construct tramways from Forest Hill to Catford *via* Sydenham, at a cost of £75,000, exclusive of street widenings, which are estimated at £150,000, and paving the breasts of the road with wood, which would cost a further £18,000.

Malvern.—At a meeting of ratepayers it was decided by resolution to call upon the U.D.C. to support the preamble to the Bill before Parliament seeking powers to establish trackless electric cars in the town. The U.D.C. recently decided to oppose the Bill, and there have been communications with a London company relative to a service of motor-'buses for the town. It is contended by the opposition that trackless cars would disfigure the beauty of the town and lead to an increase in the rates.

Manchester.—A B. of T. inquiry was opened at the Manchester Town Hall last week by Sir David Harral into the application of the Tramway and Vehicle Workers' Association for an eight-hours day for Manchester tramway men. Alderman Bowles (chairman of the Manchester Tramway Committee) and Mr. McElroy (general manager of the undertaking) represented the tramway authorities, and Alderman G. T. Jackson (general secretary of the men's Trade Union) supported the claim for an eight-hours day. The proceedings were conducted in private.

On Tuesday (18th) the Tramways Committee decided to allocate £75,000 to the relief of the rates—the same as last year. The total income was £810,800. During the coming year £56,000 has been estimated as the amount required for the new lines and permanent way expenditure, and it is estimated that for the year ending March 31st, 1912, the total expenditure will be £731,700 compared with approximate expenditure of £730,624 for the year just closed. The approximate income for the past year was £809,688, and the estimated income for the ensuing year is £810,800, and of this sum £2,500 will come from the parcels department. Chief items of estimated expenditure are:—Traffic expenses, £228,375; general expenses (salaries of administrative staff, &c.), £80,475; repairs and maintenance, £89,900; power expenses, £121,800; interest on loans, £43,974; sinking fund and loan instalments, £50,856; renewals and depreciation, £82,970. In addition to the £75,000 for the relief of the rates, the Committee has apportioned £4,100 to the old infirmary site, purchase interest, &c.

Mansfield.—Major Pringle, of the B. of T., on the 18th inst., inspected the tramway extension from Mansfield Market Place to the Crown Farm Colliery, and met a deputation of Church Street tradespeople, who had petitioned the Board against the street being used for a regular tramway service, on account of its narrow width.

New Zealand.—The Hastings Council is inviting offers for the construction of a tramway in the town. The Palmerston B.C. is considering the Edison battery car in connection with the tramways, which it is proposed to construct at a cost of £61,000. The Wanganui B.C. is extending its power station in connection with the supply to Castlecliffe tramways.—*Board of Trade Journal.*

Rotherham.—A deputation, consisting of the Deputy Mayor, the chairman of the Tramways Committee, and the engineer and general manager, has been appointed to visit and inspect railless car systems on the Continent.

Salford.—The Corporation has declined to insert provisions in the draft of the lease of the tramways by the Swinton and Pendlebury Council to the Corporation, as asked by the Swinton authority. The draft dates from January 1st, 1905, and is for a period of 21 years.

Scarborough.—The tramway service, after being suspended all the winter owing to the financial difficulties of the Scarborough Tramways Co., was resumed on Monday morning. The Corporation has been informed by the company that the cars will now continue to run, and that the service will in future be maintained throughout the winter. On the same day as the resumption of the service the T.C. held its monthly meeting, and after some discussion, decided to abandon the position which had been agreed upon in committee to press the B. of T. to determine the powers of the company to run cars in the streets. Instead, it decided to ask the Board to defer action in the matter. The chairman of the Committee having the matter in hand, informed the Council that "an assurance was given that the company had tided over its present financial difficulty, and that it would continue during the next winter to run cars." The Deputy-Mayor contended that a promise by the company was not to be trusted, as it had set the Corporation and the B. of T. at defiance. He demanded guarantees. However, the majority of the Council were not with the Deputy-Mayor, and the decision stated above was arrived at.

South Lancashire.—The Parliamentary agent of the Swinton and Pendlebury District Council has agreed with the promoters of the South Lancashire Tramway Co.'s Bill upon terms which effectually protect the interests of the Council, and the petition against the Bill is being withdrawn.

Tunis.—La Société des Tramways de Tunis is in negotiation with the Tunis Government for the concession for the construction and working of an electric tramway to connect Tunis with Rades and Hamman-Zif.

TELEGRAPH and TELEPHONE NOTES.

China.—Last week arrangements were completed for raising a loan, repayable by 1930, for the development of the Chinese inland telegraphs, which are said to be at present the worst in the world.

French Colonies.—A scheme has been formulated for linking up the French African colonies with wireless telegraphy, and a wireless station with a radius of 4,000 miles is to be erected near Saigon, in French Indo-China.

German Colonies.—The Post Office estimates which were recently adopted by the German Reichstag, include a considerable sum as proposed expenditure for the improvement of telegraphic communication in the African protectorates. New overhead lines, at a cost of £10,700, are to be erected in the Cameroons, German East Africa, Togo and South-West Africa. A further amount of £21,000 has been appropriated for wireless stations in the Cameroons and South-West Africa, whilst experiments with wireless telegraphy are to be made at an outlay of £10,000.

Letter-Telegrams in France.—The letter-telegram system has now been in use in France for a few months. For a fee of 5d. for the first 50 words or less, and 10d. for 100 words afterwards, letters of any length are telegraphed from any part of the country to any other part after midnight, and are delivered by the first post next morning.

Postal Clerks' Conference.—At the annual Conference of the United Kingdom Postal Clerks' Association at Leicester, a scheme was adopted for the amalgamation of the Postal Telegraph Clerks' Association and the United Kingdom Postal Clerks' Association, providing that both societies be dissolved, and that the new society be styled "The Postal and Telegraph Clerks' Association." An amendment was carried repudiating the principle adopted by the Executive Committee that all male candidates for sorting clerkships or telegraphist posts must enter as boy messengers, as being fatal to the highest efficiency and unjust.

Telephone Employés' Conference.—At the annual conference of the Amalgamated Society of Telephone Employés, held at Leeds last week, a resolution was passed instructing the executive to take immediate steps to improve the conditions of working of the provincial operating staff.

The Telephone Transfer.—Questioned as to the transfer of employés of the National Telephone Co. to the Post Office, Mr. Herbert Samuel said they would enjoy the advantages of the rank and grade to which they were admitted, and in so far as their salaries had not been raised on account of duties connected with the transfer, or in any way abnormally since January 1st, 1909, he thought the rates of pay would not be less, and in many cases would be greater, than had been paid by the company.

Train Telephones.—The installation for wireless inductive telephony and signalling to and from moving trains on Mr. Von Kramer's system, which has been laid down by the Stratford-on-Avon and Midland Junction line from Stratford to Kineton, a distance of 10 or 11 miles, was to be opened yesterday.

CONTRACTS OPEN and CLOSED.

OPEN.

Aldershot.—May 2nd. Replating batteries at the Electricity Works, for the U.D.C. See "Official Notices" to-day.

Australia.—May 8th. Battery of accumulators, with boosters and switchboards, for the Melbourne City Council. See "Official Notices" February 24th.

May 16th.—10,000 telephone protectors, for the P.M.G.'s Department in Victoria. See "Official Notices" March 31st.

May 23rd.—Deputy P.M.G., Melbourne. Telegraph and telephone material.

May 30th.—One portable petrol-driven desiccating plant, for the P.M.G.'s Department in Victoria. See "Official Notices" April 7th.

May 31st.—7,000 insulators and wire and line material, for the P.M.G.'s Department in South Australia. See "Official Notices" April 7th.

June 7th.—Deputy P.M.G., Sydney. Two nauts (4,052 yd.) of submarine telephone cable.

June 14th.—Switchboard, common-battery, multiple, for the P.M.G.'s Department in South Australia. See "Official Notices" February 3rd.

June 14th.—Branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" February 3rd.

July 25th.—Deputy-P.M.G., Melbourne. Twelve sections of a branching multiple magneto lamp signalling switchboard, &c., or one automatic or semi-automatic switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" March 24th.

Austria-Hungary.—April 29th. 1,800-H.P. steam turbine, three-phase generator, 3,000 volts, condenser, conducting material, switchboard, two steam boilers, &c. (£17,000 is earmarked for these purposes). Deposit 5 per cent. Director des Stadtischen Elektricitätswerkes, Nagyvárad.

Barnes.—May 9th. Combination de-oiling, softening and feed-heating plant, for the U.D.C. electricity works. See "Official Notices" to-day.

Bulgaria.—The date for sending in tenders for the electric lighting installation at Varna has been extended from April 19th to May 18th.

Chesterfield.—April 24th. Uniforms for the Corporation Tramways; R. C. Acland, Engineer and Manager, Chatsworth Road.

Derby.—Inverted rotary converters, E.H.T. cables and E.H.T. switchgear, for the Borough Electricity Department. See "Official Notices" April 7th.

Dublin.—April 26th. Electric lighting of the Charleville Mall Public Library (new portion); City Electrical Engineer, Fleet Street, Dublin (specifications, 10s. 6d., returnable).

Egham.—April 24th. Two high-speed Diesel oil engines, coupled to 100-KW. single-phase alternators, with exciters, piping, &c.; one 4-ton overhead traveller, and main high-tension switchboard, for the Egham and District Electric Lighting Co., Ltd. See 'Official Notices" April 7th.

Glasgow.—April 24th. Steam turbo-alternator, with condensing plant, for the Corporation tramways See "Official Notices" March 17th.

Halifax.—May 3rd. 14,000 tons of pea slack coal for the Corporation Electricity Works; W. M. Rogerson, General Manager, Foundry Street (returnable deposit of £5).

Haslingden.—May 5th. Extra-high-pressure trunk mains, with medium-pressure feeder and distributor cables, for the Corporation. See "Official Notices" to-day.

Hornsey.—April 24th. Flame arc lamps, for the T.C. See "Official Notices" March 31st.

Ilford.—May 9th. Distributing switchboard, feeder cable and stoneware conduits, for the U.D.C. Electricity Department. See "Official Notices" to-day.

London.—FULHAM.—April 26th. One 1,500-KW. turbo-alternator, with condensing plant, for the B.C. See "Official Notices" to-day.

L.C.C.—Tenders are to be invited for four car-traversers at carsheds, also for the erection of a workshop, store, &c., at the Stockwell sub-station; also for two motor cars for the use of the chief engineer's department and the tramways department.

April 28th.—Carbon and metal-filament lamps, for a year, for H.M. Office of Works. See "Official Notices" to-day.

May 5th and 10th.—(*a*) Electric gas torches for one year, (*b*) opal lamp shades for three years, for H.M. Office of Works. See "Official Notices" to-day.

Luton.—April 24th. Turbine generators, condensing plant, and cooling tower, for the Corporation Electricity Department. See "Official Notices" April 14th.

Margate.—May 8th. Electric lighting of the Fort Concert Pavilion, for the Corporation. See "Official Notices" to-day.

Russia.—It is reported that the municipal authorities of Blagowjeschtschensk, in the Amur district of Russia, are about to invite tenders for the construction and working of an electric tramway in the town.

Salford.—April 24th. Fire and police alarm, street-boxes and necessary switchboard. Chief Constable, Town Hall.

South Shields.—May 24th. One 1,500-KW. high-pressure impulse-type steam turbine, with surface condenser and pumps, coupled to one 1,000-KW. D.C. generator, with switch panel and instruments, and one 1,100-KW. A.C. generator, with switch panel and instruments, in tandem, for the Corporation. See "Official Notices" to-day.

Swansea.—April 24th. 2,000 brass condenser tubes, for the Corporation Electricity Department. See "Official Notices" April 14th.

Spain.—May 5th. 50 tons of steel or iron telegraph wire. Dirección General de Correos y Telégrafos, Madrid. Tenders for Spanish material only in the first instance, and if this adjudication is without result, another call will be issued for foreign firms to participate in the tendering.—*Board of Trade Journal.*

Turkey.—June 14th. H.M. Consul-General at Constantinople reports that tenders are invited by the Turkish Ministry of Public Works, Constantinople, for a concession for the public distribution of electrical energy and for electric tramways in Jerusalem and its suburbs. For further particulars see this column last week.

Walthamstow.—April 28th. Cooling tower and switchboard extension, for the U.D.C. Electricity Department. See "Official Notices" April 7th.

Worthing.—April 24th. Replating the storage battery for the Borough Electricity Department. See "Official Notices" to-day.

CLOSED.

Australia.—SYDNEY.—The contract for 270 1,200-ampere-hour cells and 270 2,400-ampere-hour cells, for Darlinghurst and Burwood Tramway sub-stations, has been placed with the Chloride Electrical Storage Co., Ltd.

Belgium.—La Société des Ateliers de Constructions Electriques, of Charleroi, have submitted the lowest tender for the supply and installation of an electric lighting and power plant at the Ecole de Pyrotechnie at Antwerp.

Bolton.—The Tramways Committee has accepted the tender of Mr. Chas. H. Blume for insulating compound.

(*Continued on page* 643.)

ELECTRICALLY-DRIVEN REVERSING MILLS.

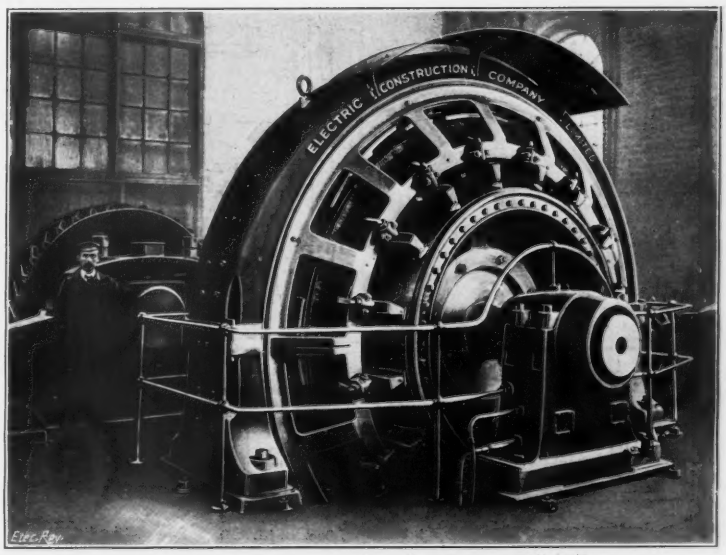
MESSRS. ALFRED HICKMAN, Ltd.

The problem of electrically driving the reversing rolling mill and the winding engine—particularly the former—is, as is well-known, one of the most difficult which the electrical engineer has undertaken. This is probably due as much to prejudice in favour of old and tried methods as to anything else, as where sufficient time has elapsed in order to give electrical plant an opportunity of being understood by the user, the objections to its use, which looked so formidable beforehand, usually disappear.

One of the best examples in this country of the reversing rolling mill, driven electrically, is the installation at Messrs. Alfred Hickman's Staffordshire Steel and Ingot Iron Works, which was supplied by the Electric Construction Co., Ltd., of Wolverhampton, and has been referred to from time to time in our pages.

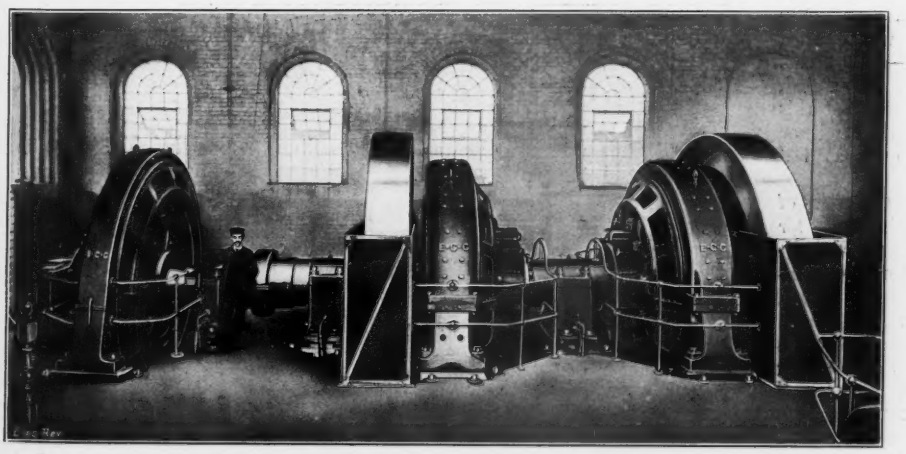
The mills equipped at these works are amongst the largest in the world, certainly the largest yet laid down in this country. They consist of a 30-in. cogging mill and a 24-in. bar mill, and the electrical equipment comprises two reversing mill motors and a fly-wheel motor-generator set. The plant presents new and interesting features, since it is the only equipment in which the variable voltage generators and the motors work at ± 1,000 volts pressure, and in which, contrary to Continental practice, mills of so large a size are driven by single motors. The driving losses are considerably lower than those which usually occur in plant of corresponding output, and the space occupied is smaller.

When the contract was made for the supply of the equipment, a guarantee was given that the time of reversal for each mill motor should not exceed 6 seconds from the maximum speed in one direction to the maximum speed in the opposite direction. In practice the machines are able to reverse well within this guarantee.



Cogging Mill Reversing Motor: 4,800—9,600 B.H.P.

The fly-wheel motor-generator set consists of one motor, two fly-wheels and two generators, each generator being in direct electrical connection with its own mill motor. Power is supplied from the central station to the motor of the fly-wheel set at 460/500 volts, continuous current. The motor is shunt-wound, and is designed to develop 2,000 B.H.P. as continuous working load. The magnetic circuit of the motor is laminated throughout, so that the speed answers directly to the automatic regulator described later. The generators are both separately excited, and supply current to the mill motors at a pressure of from 0 to ± 1,000 volts. The efficiency of each of the three machines is 94½ per cent. at full load. Each of the two fly-wheels is 14 ft. in diameter, and weighs 28 tons, the peripheral speed being about 15,400 ft. per min.; each is built of three separate steel castings only, machined and polished to reduce air-friction losses. The maximum speed of the set is 350 R.P.M., which speed is decreased by means of the automatic regulator to 290 R.P.M.



Flywheel Motor-Generator Set Supplying Current to Cogging Mill and Bar Mill Motors.

For starting the fly-wheel motor-generator set an arrangement is provided which connects the armature of the cogging mill generator in series with the armature of the motor. This arrangement is economical in current consumption and in time required for starting, and allows a comparatively small starting resistance to be used.

The motor of the fly-wheel motor-generator set is excited from the 460/500-volt bus-bars, and an efficient emergency electric brake is obtained by connecting its armature across the starting resistance.

As indicated above, the speed of the fly-wheel set is made to vary from 15 per cent. to 18 per cent. below the maximum in order that the fly-wheels may supply the power required to equalise the peaks in the load. To obtain this variation in speed, the motor of the fly-wheel set has a resistance in the shunt field-magnet circuit, the amount of this resistance being varied by an automatic regulator operated by the current taken by the motor. This regulator is arranged to come into operation whenever the current input rises above

or falls below a predetermined value, and is guaranteed to equalise the load on the generating station to within 20 per cent. of the average load.

The cogging mill is used for cogging 2½ ton ingots to blooms of 4½ in. to 6 in. section. The motor is in the same building as the fly-wheel motor-generator set, and, as shown in our view, is connected to the rolls through two-to-one gearing. The motor will develop 4,800 B.H.P. at 1,000 volts for five-second periods six times per minute as a rolling load, and a maximum load of 9,600 B.H.P. for two-second periods once every hour. The speed of the motor is ± 120 R.P.M., at which speed (120 R.P.M.) the output is measured, and it is excited off the 460/500 volt bus-bars. This machine was designed to reverse from + 120 to — 120 R.P.M. in six seconds, and, as already stated, it has been found in practice that this is easily accomplished. The efficiency of the motor is 94½ per cent. at full load.

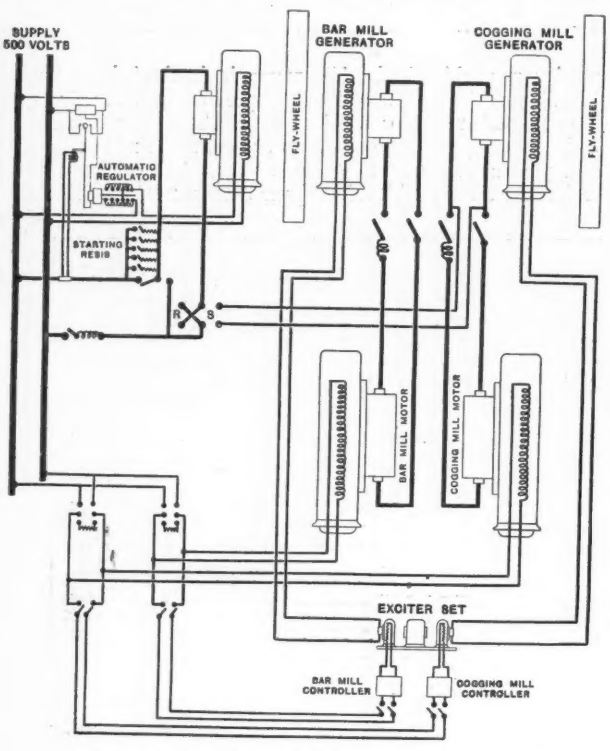
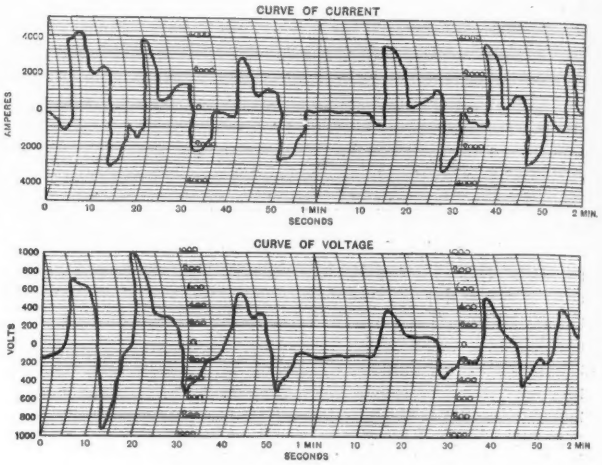


Diagram of Connections of Electrically-Operated Reversing Rolling Mills.



Typical Current and Pressure Curves; Cogging Mill Motor.

The bar mill contains two sets of housings and rolls, and is built for rolling sheet bars, billets, rounds, angles, &c. The motor is connected directly to the rolls, and will develop 6,000 B.H.P. for five-second periods six times per minute, and a maximum load of 12,000 B.H.P. for two seconds, once an hour. The speed of the motor is ± 120 R.P.M., and it is excited off the 460/500 volt bus-bars. The reversing tests and efficiency are the same as on the cogging mill motor.

The speed and reversal of the mill motors is controlled by a system similar to the Ward-Leonard system, the voltage of the generators being varied between a positive and negative maximum.

The voltage variation of each generator is obtained by the operation of a single controller at a corresponding mill platform. This controller varies the field excitation of a small motor-driven exciter, which in turn varies the excitation of its variable voltage generator. Each mill motor has constant field excitation, and the speed therefore depends upon the voltage applied to the armature. Thus each position of the controller handle corresponds to a definite speed of its mill motor.

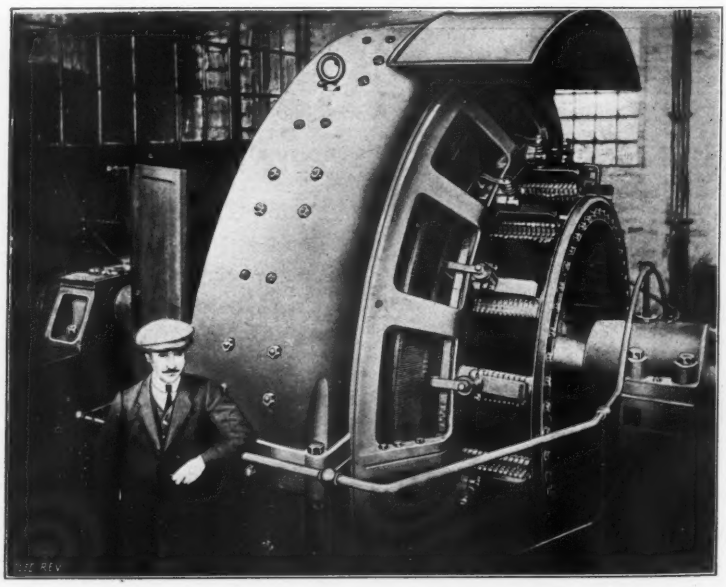
During two years' continuous work the "E.C.C." controllers in these mills have had no renewals or adjustments, nor do they show signs of requiring such attention.

It should be pointed out that with the above system of control only a small amount of energy is lost in reversing the mill, since the energy expended in accelerating the rotating masses is largely returned in the form of electrical energy when the speed is decreased.

Standard E.C.C. circuit breakers in the main circuits of the machines are mounted on the main switchboard. Switches, which can be operated by the mill driver or by a switchboard attendant, are provided for breaking the field circuits of the generators. In addition to these safeguards, the connections are so arranged that it is impossible to excite the generator field unless the field of the corresponding motor has been previously excited.

Indicators showing the speed of the rolls and of the fly-wheel motor-generator set are fitted at each mill platform, whilst the speed of the fly-wheel set can also be read from an indicator on the switchboard.

The exciter set consists of two exciters, direct coupled to, and driven by, one 75-B.H.P. motor. The motor is con-



Bar Mill Reversing Motor: 6,000—12,000 B.H.P.

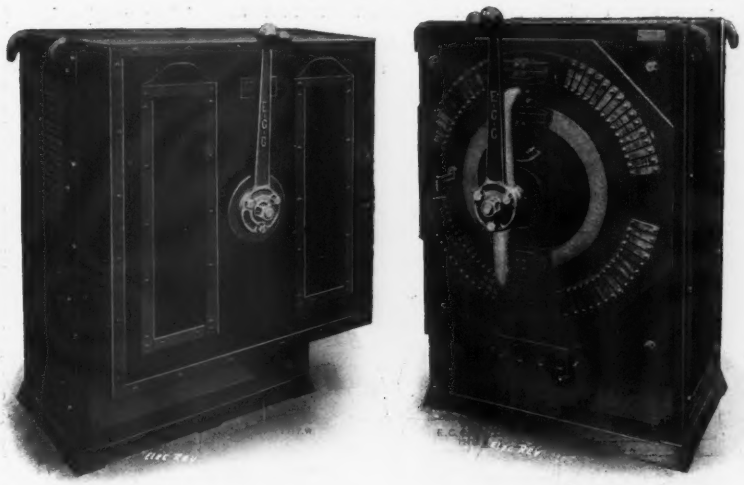
nected to the 500-volt supply, and runs at a speed of 1,500 R.P.M. The armatures of the two exciters are respectively connected direct to the field circuits of the two variable voltage generators of the converter set. The current in the field circuit of the exciters is varied in magnitude and direction by the position of the controller handle. The magnetic circuits of the exciters are laminated, in order to obtain the necessary quick reversal of flux.

An important point in the equipment of a reversing mill is the control of the live-roll motors. For this purpose the Electric Construction Co. have designed a special controller, which has met very severe working conditions with success, and is shown herewith.

This controller is of substantial construction, and a long range of speed with even acceleration is obtained.

The insulation is suitable for working in the presence of the large amount of metallic oxide dust which abounds everywhere in a rolling mill.

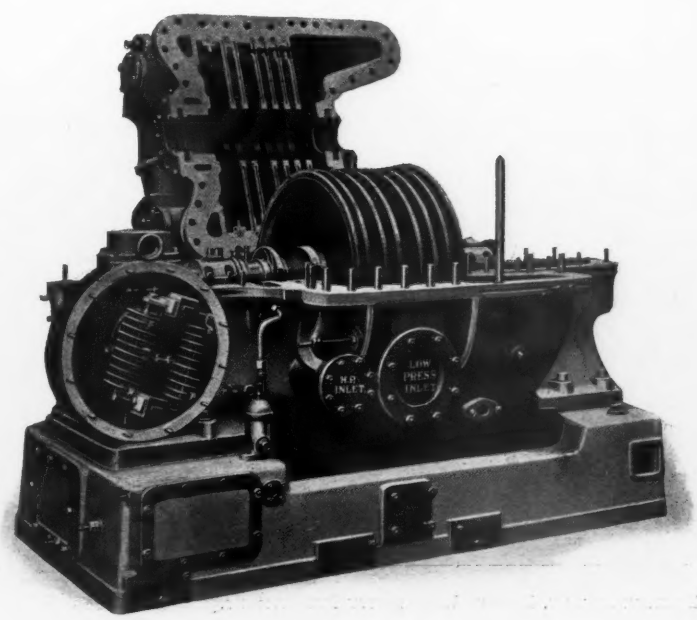
We give typical current and voltage curves of the cogging mill motor at Messrs. Hickman's, from which the quick reversal of the motor, in spite of the heavy work performed, can easily be observed.



E.C.C. Controller for Live Roll Motors (with cover removed in right-hand view).

ELECTRIC SMELTING.

The experiments that have been carried on during the past year at Trolhätten waterfalls in Sweden, with the object of smelting iron ore by means of electricity, in specially designed furnaces, appear to have been so far successful, that we may now turn our attention to the commercial possibilities of the new electrical process, which has become almost a necessity, owing to the increasing cost of charcoal in Sweden. This new process is considered to be of such great importance to the iron industries of the country, that the "Iron Office" in Stockholm has not only generously contributed towards the erection of the Trolhätten electrical plant, but has formed a committee of leading ironmasters, business men and engineers, whose duty it is to see that nothing is lacking to make the experiments a thorough success.



1,000-kw. Westinghouse Impulse Turbine, with Cylinder and Governor Opened for Inspection (see page 642).

The experimental plant has been erected at a place called Stalbacka, which is believed to be the most suitable for the future iron smelting industry of Trolhätten, on account of the great amount of water-power obtainable at this spot. The erection of the necessary works has been carried on with rapidity. On April 1st last year, the work of building the electrical smelting furnace and plant was commenced, and on November 15th everything was ready. From that day, the work of smelting and making simultaneous observations and experiments has been carried on incessantly. The experiments have been made with the greatest secrecy, and only the engineers and others connected with the work have been allowed to enter the barriers which surround the electrical plant.

A short time ago the representative of a leading Swedish paper was first allowed to enter the buildings and see how far the experiment had succeeded. This correspondent expresses his astonishment that the experiments should have been carried out on such an extensive scale, and that the Swedes appeared to have, for once, ventured to make great material sacrifices, in order to obtain material advantages. The electrical plant and buildings, which cost about £14,000 to erect, comprise a large fuel store, a crushing mill and the smelting works, which are about 65 ft. in height. There are also two railway tracks, for fuel and ore.

The ore which is used at present is obtained partly from Lapland and partly from Central Sweden; but it is intended that eventually a large number of the different kinds of Swedish ore should be used in these experiments. The smelting furnace is built of brick, and is about 45 ft. high; its interior differs from an ordinary smelting furnace in that the blast, which ordinarily helps to consume the charcoal and produce the necessary heat, is absent.

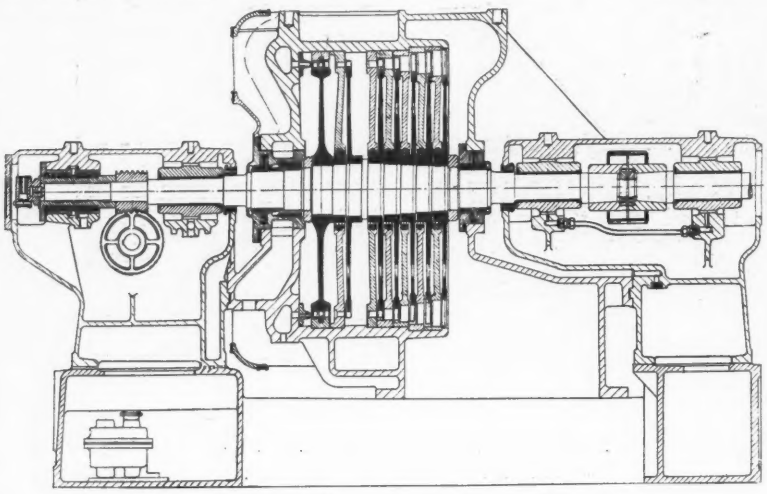
The charcoal is discharged from the railway trucks direct by means of two steel conveyers, which pass through the entire length of the loft of the fuel house. The ore is brought to the furnace by means of a railway track running between the fuel house and the smelting works, and is discharged into different heaps according to the quality. The ore is then conveyed from these heaps to the crushing house, whence it is hoisted up into the top storey of the building containing the furnace. The charcoal is also hauled up from the fuel house by means of baskets and other appliances. Both the ore and the charcoal are weighed before they are put into the shaft of the furnace.

The carbon electrodes, which are from Hogenas, Ratibor, Silesia, are large blocks 660 mm. square and 2 metres in length, and consist of four parts joined together in a water-cooled box of copper. They are inserted in the lower part of the furnace and connected with the poles of a transformer. The current passes from the electrodes through the charge, and heats the latter to the necessary temperature.

The molten metal is run off in the same manner as in an ordinary smelting furnace. About 5 tons of pig-iron is obtained at every

tapping, and altogether about 670 tons of pig-iron have been produced at Trolhätten during the short time the work has been carried on. The pig-iron is sent from Trolhätten to the different ironworks, which are shareholders in the Iron Office. The ironworks consequently have the opportunity of comparing their own pig-iron with that obtained from the electrical furnace at Trolhätten.

Experiments with this furnace will continue to be made for another two years, from not only the metallurgical, but also the constructive, point of view. Minute observations are made night and day, by a number of capable engineers specially chosen for this work.



Section through Westinghouse Impulse Turbine.

Hopes were entertained that, thanks to the new electrical process, two-thirds of the charcoal usually used in the ordinary smelting furnaces would be saved. The Trolhätten experiments seem to indicate that these hopes will be fulfilled. The pig-iron that has already been produced has turned out to be of exceedingly good quality, with a very small percentage of sulphur or phosphorus. It is also possible to produce in the new furnace both grey and white iron, also iron for Siemens-Martin or Lancashire furnaces.

It may with safety be said that work of the very greatest importance is being carried out for the reduction of Swedish ores, and of especial advantage to the Swedish iron industries.

It is hoped that, as soon as the new process becomes more generally known, Sweden will again resume her old place as one of the principal exporters of manufactured iron; for since the beginning of the last century her production of pig-iron, instead of being one-tenth of the world's output, it is now only one-hundredth part of it. Norway, Canada, Finland, Northern Russia and other countries, where water power is plentiful, will sooner or later also turn this new process to good account.

NEW WESTINGHOUSE PLANT AT ST. HELENS.

Within the last few weeks the St. Helens Corporation Electricity Department has brought into service its first alternating prime mover, a 1,000-kw. Westinghouse impulse type turbo-alternator for supplying three-phase current at 6,600 volts pressure.

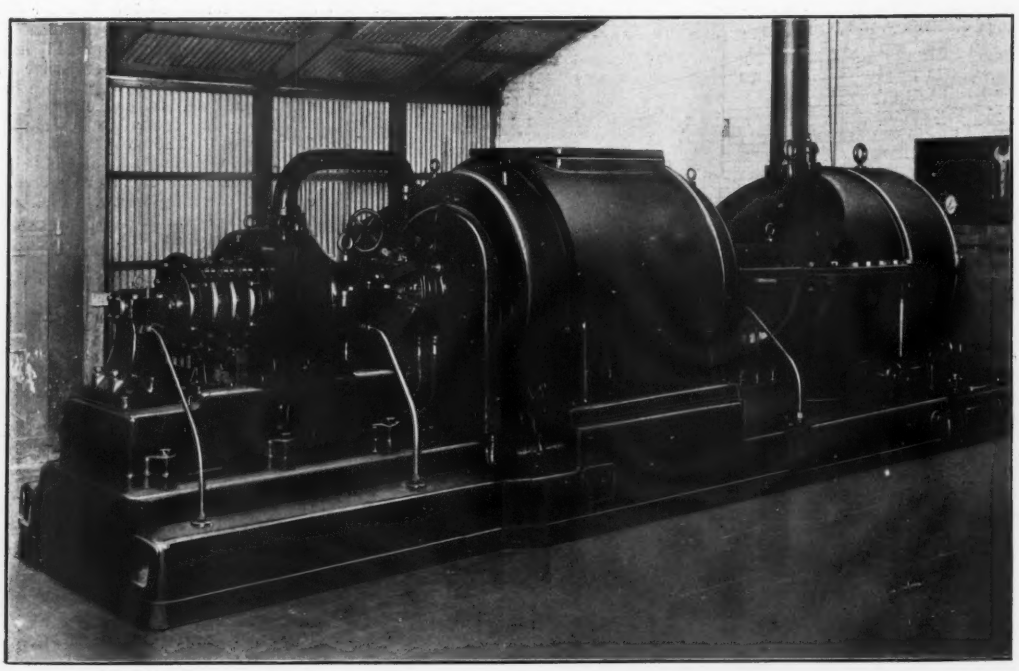
Up to the present, the whole of the A.C. supplied from the Corporation generating station has been generated by two rotary converter sets of 500 and 250-kw. capacity respectively, which also were constructed by the Westinghouse Co. These rotaries were designed to be reversible; and while in the past they have, of course, operated from the D.C. station plant, they will in future be found very useful for running in the opposite way, and linking up the new turbo-alternator with the older direct-current plant in the station.

The new turbo-alternator has a speed of 3,000 R.P.M.; the steam consumption guaranteed by the makers was 15·9 lb. per KW.-hour on full load, and on test only 15·64 lb. was required, the steam pressure being 160 lb.

As previously mentioned, the turbine is of the impulse type, consisting of a series of stationary guiding diaphragms fixed in the cylinder and rotating wheels on the shaft, the arrangement being shown on page 641, where the upper half of the casing and diaphragms is lifted.

The bearings are supplied with oil under pressure from an oil pump, which is gear driven from the governor shaft, itself worm driven from the main turbine shaft. An emergency governor is fitted which comes into action should the ordinary governor gear fail; also water glands are provided on each end of the turbine casing in order to make the latter steam and air-tight.

The turbine exhausts to a low-level jet type condenser, manufactured by Messrs. Mirrlees Watson, with Westinghouse motors driving the various pumps. As will be seen from our view, the 6,600-volt alternator is totally enclosed, forced air circulation being provided for cooling; for excitation a small exciter is mounted on an extension of the bed plate.



Westinghouse Impulse Turbine Set, St. Helens Electricity Department.

CONTRACTS CLOSED.

(*Concluded from page* 638.)

Bristol.—The T.C. has accepted the tender of the Bedminster, Easton, Kingswood and Parkfield Collieries, Ltd., for the supply of coal to the Avonbank electricity works for a year. The total value of the contract is £12,687 10s.

Buenos Ayres.—It was mentioned at the recent meeting of the Anglo-Argentine Tramways Co. that contracts had been entered into for the construction of the underground subway for passenger traffic from the Plaza Once to Plaza Mayo. The work on this first section of the underground electric railway, according to a report from Frankfort-on-Main, has been entrusted to the firm of Philip Holzmann & Co., of that city, and is to be begun this year. The length of the section is 2·48 miles, and electrical machinery is to be employed in connection with the sinking of the shafts and the transport of materials.

Cheltenham.—The T.C. has accepted the modified tender of the Phœnix Dynamo Manufacturing Co. for a motor-generator, at £537 10s.

Glasgow.—The Electricity Committee has recommended acceptance of the following tenders :—

Low-tension cables.—Callender's Cable Co.
Extra-high-tension cable.—W. T. Glover & Co.
Rubber-covered cable.—Drake & Gorham, Ltd.
Flexibles.—Ward & Goidstone.

Acceptance has also been recommended of the offers by the following firms to supply the quantities of new meters (any size) aftermentioned, at a specified price, in exchange for an equal number of obsolete meters, viz. :—

British Thomson-Houston Co.	200 meters.
Ferranti, Ltd.	800 "
Chamberlain & Hookham	800 "

Gravesend.—The T.C. has accepted the tender of the Electrical Apparatus Co. for small electric meters ; and those of Messrs. Ferranti, Ltd., and the British Thomson-Houston Co., Ltd., for large ones.

Great Yarmouth.—The T.C. has accepted the tender of the British Chilled Iron and Steel Co. for 60 steel tires for tram-cars, at £1 14s. each ; and that of the British Westinghouse Electric and Manufacturing Co., Ltd., for 36 gear wheels, at £2 12s. 6d. each.

Halifax.—The B. of G. has accepted the tender of Mr. S. Hodgson, of Halifax, for electrical fittings.

India.—The Maschinenfabrik Oerlikon, of Oerlikon, Switzerland, have lately secured a contract for the supply to a cotton mill near Bombay of three alternating generators of 900 H.P. each, and 250 small electric motors for the driving of ring spinning mules.

London.—Hammersmith.—The tenders received by the Electricity Committee for 40 tons of cement, manufactured on the rotary process, required for the foundations of the new 3,000-kw. turbo-generator, were as follows :—

		Per ton.
Wouldham Cement Co., Ltd.	(accepted)	24s. 5d.
Associated Portland Cement Manufacturers (1900) ..		24s. 9d.
Saxon Portland Cement Co., Ltd.		28s. 0d.

The tenders for 24 panels of sub-station switchgear were :—

Spagnoletti, Ltd.	(accepted) £269
Ferranti, Ltd.	271
B. Thomas	283
Johnson & Phillips, Ltd.	289
British Thomson-Houston Co., Ltd.	319
Siemens Bros.	339
General Electric Co., Ltd.	358
Electric and Ordnance Accessories Co., Ltd.	366
British Westinghouse Co., Ltd.	448
Electric Construction Co., Ltd.	462
Reyrolle & Co., Ltd.	529

For transformers the figures submitted were :—

	Two 100-kw.	Two 200-kw.	Total.
British Electric Transformer Co. (accepted)	£179	£298	£477
British Thomson-Houston Co.	179	313	492
W. E. Burnand & Co.	173	326	499
British Westinghouse Co.	204	340	544
Foster Engineering Co.	180	—	180

The following tenders were received for steam-raising plant, consisting of water-tube boilers, with superheaters, forced-draught furnace, mechanical stokers, economisers, &c. :—

Name.	Price.	Output per boiler.	Coal burned per hour.	Heating surface. Boiler.	Heating surface. Whole plant.
	£	lb.	lb.	Sup. ft.	Sup. ft.
Stirling Boiler Co. ..	5,007	20,000	1,800	6,903	—
Do.	5,602	40,000	3,570	"	—
Do.	6,979	40,000	3,570	—	19,526
Howden & Co.	5,790	20,000	1,885	4,800	—
Do.	6,510	21,000	1,800	"	—
Do.	5,110	—	—	"	—
Clarke, Chapman	6,279	19,000	1,900	4,900	—
Do.	6,686	31,200	2,870	"	—
Do.	6,999	31,300	2,870	"	—
Do.	8,000	31,300	2,870	"	—
Babcock & Wilcox ..	6,718	23,000	2,040	6,182	—
Do.	7,618	30,000	3,780	"	—
Fraser & Chalmers ..	9,510	40,000	3,810	—	19,872
British Niclausse Co.* ..	3,490	—	—	—	—
Hawksley, Wild & Co. ..	9,602	21,610	2,560	5,688	—

* Boiler only.

In reporting upon these tenders the Committee state that having regard to the price, the output of steam per hour, and the heating surface respectively, the most favourable schemes are those submitted by (1) The Stirling Boiler Co., £5,602 ; (2) Messrs. Fraser, Chalmers & Co., £9,510. Upon the offer of Messrs. Fraser, Chalmers and Co., the engineer has pointed out that this furnace is constructed to burn coal-dust and the coal is pulverised as required. The labour item is reduced to a minimum. The plant offered gives the largest output of any tender, viz :—Normal continuous output equivalent to 40,000 lb. per hour ; overload (2—3 hours) continuous output equivalent to 60,000 lb. per hour. The smoke stack offered is, however, too short, and an economiser is an essential part of the boiler, the output being reduced about 25 per cent. if dispensed with. With extreme care in mixing, the furnace will burn small fine anthracite in proportion of 5 of anthracite to 1 of bituminous.

After a careful comparison of the two schemes in question the engineer has presented the following report :—

"The proposition put forward by Messrs. Fraser & Chalmers for their dust-fired boiler is undoubtedly very attractive, but, after carefully considering the details of their tender, I have come to the conclusion that the extra price asked outweighs the advantages. Moreover, there is every probability that some of the advantages can be obtained with less expense by adopting one of the new forms of travelling grate stokers arranged to work in connection with the hot air forced draught systems. The tenders include a separate item for the supply of economisers, but it appears that the price is out of all proportion to the saving to be effected, especially when it is remembered that the chimney power will have to be increased in order to deal with a greater friction and lower temperature of the gases when an economiser is installed. I, therefore, consider that this matter should remain over until we have a permanent brick stack of large dimensions when economisers can doubtless be efficiently used. In the meantime, however, greater efficiency can be obtained by heating the air of combustion with waste gases, as on the latest boilers installed, and using exhaust steam from the auxiliary plant for heating the feed water to nearly boiling point. The lowest tender in comparison with the size of the boiler is that of the Stirling Boiler Co., which, with hot air, forced draught and all necessary auxiliaries, is £5,602. For this price the makers guarantee 80 per cent. efficiency with maximum output, but for a further expenditure of £229 for larger air heater an extra 2½ per cent. efficiency is guaranteed. I recommend that a larger air heater be supplied and so obtain this greater efficiency."

The Committee state that they agree with the observations of the electrical engineer, and are of opinion that the Council will be well advised to obtain the 2½ per cent. higher efficiency guaranteed upon the extra outlay of £229 on large heaters, and recommend :—That the tender of the Stirling Co. at £5,602 be accepted subject to such modifications as may be hereafter considered desirable in connection with the installation of larger heaters and the erection of a smoke stack.

The following tenders were received for the supply of special fittings required in connection with the scheme for converting the public lighting in the main roads from arc to metallic-filament lamps, approved by the Council at its last meeting, viz :—

200-D.P. ironclad fuse-boxes :—

Universal Electrical Manufacturing Co. ..	(accepted)	£25 0
W. Lucy & Co., Ltd.		27 0
Marryat & McNaught		27 10

185 sets of tinned-copper joint-box connections :—

Universal Electrical Manufacturing Co. ..	(accepted)	£18 15
Sykes & Sugden		19 10
W. Lucy & Co., Ltd.		20 0

17 cast-iron feeder pillars with switches and fuses :—

	Pillars only.	Pillars with switchgear.
Universal Electrical Manufacturing Co. .. (accepted)	£56	£86 15
Sykes & Sugden	75	112 8
British Insulated and Helsby Cables, Ltd.	79	117 14
Blackwell & Co.	65	118 8
Marryat & McNaught	89	167 7
Dick, Kerr & Co., Ltd.	116	241 14
Allen Senior & Sons	102	—
Callender's Cable Co.	96	250 6

Hardy & Padmore quote 5 per cent. off list for pillars only.

Fulham.—The B.C. Electricity Committee recommends coal contracts as below :—

Gilman & Co.—1,000 tons Mapperley Smitham ⅞-in. nutty slack, at 10s. 10d. per ton.
W. Cory & Sons.—1,000 tons Northumberland rough slack, at 9s. 3d. per ton.
Hinchliffe & Co.—1,000 tons Bagworth ⅞-in. nutty slack, at 8s. 6d. per ton.

Marylebone.—The B.C. has accepted the following tenders :—

Babcock & Wilcox.—Two superheaters, £250 each.
Tudor Accumulator Co., Ltd.—Additional cells (78) at Manchester Square and Rathbone Place sub-station batteries, £2,541.

Kensington.—The B.C. has accepted the tender of J. Defries and Sons, Ltd., at £425, for the illumination and decoration of the public buildings on the occasion of the Coronation.

Westminster.—The City Council has accepted the tender of Speedy, Enyon & Co. for the illumination by electricity of Piccadilly, between Constitution Hill and St. James Street, at the Coronation, for £1,000, this sum to include the supply of current.

The Metropolitan Asylums Board has placed an order with Messrs. W. J. Fryer & Co. for installing electric light in the new operating room in the Park Hospital, at £27 18s. An agreement has been entered into with Messrs. Pritchetts & Gold for the renewal of their maintenance of the electric storage battery at the Grove Hospital for a further period of five years, at £75 per annum.

Newport (Mon.).—The T.C. has accepted the tender of Messrs. R. Alger & Sons for installing the electric light at the new Higher Elementary Schools, at £488.

Norwich.—The tender of the Premier Accumulator Co., Ltd., for battery required and maintenance for 10 years, has been recommended for acceptance by the Corporation.

Rotherham.—The T.C. has accepted the tender of the British Westinghouse Co., at £4,457, for additional electric lighting plant, subject to the sanction of the L.G.B.

Southend-on-Sea.—The T.C. has accepted the tender of the North-Eastern Steel Co., Ltd., for from 650 to 750 tons of Sandberg steel rails (No. 4 B S S), at £6 10s. per ton.

Stoke-on-Trent.—The Corporation Electricity Committee has accepted the tender of Messrs. Jas. Howden & Co., of Glasgow, for a turbine, alternator, and condensing plant for the new power station, at £8,905.

Swindon.—The Corporation Electricity Committee has accepted the tender of the Electrical Apparatus Co., Ltd., for the supply of a portion of its meter requirements for the current year.

Tonbridge.—The U.D.C. has accepted the offer of the Electrical Apparatus Co., Ltd., for the supply of meters (motor type) for the year ending March, 1912.

Torquay.—The T.C. has accepted the tender of the Rees Roturbo Manufacturing Co., Ltd., at £332, for a motor-driven pumping plant.

Valparaiso.—The British Westinghouse Electric & Manufacturing Co., Ltd., have received an order from Mr. R. Jeffry for Pedro Perfetti Valparaiso for Tres Marias Oficina for two 75-KW. 230-volt D.C. generators and control gear; one 80-H.P., four 13-H.P., two 31-H.P., 220-volt D.C. motors and control gear.

Wakefield.—The T.C. has accepted the tender of Messrs. McPhail & Simpson, Ltd., for three superheaters for the electricity works, at £360.

Walsall.—The T.C. has placed an order with the Equipment and Engineering Co., of London, for half a mile of Phono-Electric trolley wire, at 9d. per lb., the approximate cost being £33. The tender of Alfred Hall for supplying and fixing an armature drying stove packed with silicate cotton, complete with fittings, together with an armature trolley to carry two armatures, at £18, has been accepted; as has also that of J. & F. Wootton for erecting a new sub-station at Bloxwich, at £130.

Watford.—The U.D.C. has accepted the following tenders:—

W. T. Henley's Telegraph Works, Ltd.—Twelve months' supply of cable.
Drake & Gorham, Ltd.—Conversion of 550 street lamps from carbon filament to metallic filament.

West Ham.—The Corporation has accepted the tender of Hadfield's Steel Foundry Co., Ltd., for 200 steel wheels for the tramcars.

Wimbledon.—The T.C. has accepted the following tenders for annual supplies for the Electricity Department:—

Cables and conduits:—
Western Electric Co., Ltd.—Cables and pilot wires.
Albion Clay Co., Ltd.—Sykes conduits.
Doulton & Co., Ltd.—Doulton conduits.
Joint-boxes and jointing materials:—
Dussek Bitumen Co.—Compound.
British Insulated and Helsby Cables, Ltd.—Tapes, sealing ends and rubber mats.
W. Luey & Co., Ltd.—House-service boxes, main and link joint-boxes, and lead sleeves.
Sykes & Sugden.—House fuse-boxes.
Callender's Cable and Construction Co., Ltd.—Copper bars, and frames and covers.
Foster Engineering Co., Ltd.—Transformers.
General Electric Co., Ltd., and Ferranti, Ltd.—Meters.
Siemens Bros. & Co., Ltd.—V.I.R. cables.
General Electric Co.—Accessories.
J. & H. Grevener.—Flame arc lamp carbons.

Wolverhampton.—The District Electric Co., Ltd., are to carry out the electric lighting installation at the Newhampton Road Wesleyan Church, Wolverhampton.

FORTHCOMING EVENTS.

Illuminating Engineering Society.—Monday, April 24th. At 8 p.m. At the Royal Society of Arts. Papers on "The Ratio of Light to Illumination," by Mr. H. T. Harrison, and "Some Notes on the Effect of Wall-papers on the Illumination of Interiors," by Mr. P. J. Waldram.

National Electrical Manufacturers' Association (Inc.).—Tuesday, April 25th. At 8 p.m. At the I.E.E., Embankment, W.C. Paper on "Foreign Compared with Home Industrial Finance," by Mr. L. Joseph.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, April 26th. At 7.30 p.m. At the University, Birmingham. Paper on "Battery Economics and Battery Discharge Arrangements," by Mr. A. M. Taylor.

Institution of Electrical Engineers (Students' Section).—Wednesday, April 26th. At 7.45 p.m. Paper on "Single-phase Commutator Motors, especially the Latour-Winter-Eichberg Motor," by Messrs. Page and Scott.

Institution of Electrical Engineers.—Thursday, April 27th. At 8 p.m. Paper on "Battery Economics and Battery Discharge Arrangements," by Mr. A. M. Taylor.

Physical Society.—Friday, April 28th. At 5 p.m. At the Imperial College of Science, South Kensington. Papers on "High-Tension Electrostatic Wattmeters," by Prof. E. Wilson; "Previous Magnetic History as Affected by Temperature," by Prof. E. Wilson and Mr. L. C. Sudd; "Note on the Behaviour of Incandescent Lime Cathodes," by Dr. R. S. Willows and Mr. T. Pigeon; and "The Formation of Dust Striations by an Electric Spark," by Dr. S. Marsh and Mr. W. H. Nottage.

NOTES.

Electric Shock Fatality.—At Blackpool on Wednesday, 12th inst., an inquest was held on the body of Thos. George Sidney (27), of 21, Leeds Road, Blackpool, who was employed in the electricity department of the Blackpool Corporation, and who was killed whilst at work on a street main.

John Appleton, outside foreman in the electricity department, stated that all day on Monday Sidney, Jas. Lamb, and himself were engaged on an arc circuit in Abingdon Street, and about 7.30, whilst they were at the base of the electric lamp pillar, Sidney inquired if there was any leakage, and witness answered, "No; and if you get anything it will be H.T.." Sidney observed, "I have got something, and it has made me sweat." Witness said, "For God's sake don't touch, and I will telephone to the works and get it clear." Witness went to the nearest telephone, and was informed that the circuit upon which they were working was on, but that it would be taken off immediately. He returned to the job, and found Sidney lying on the floor unconscious. A doctor was at once sent for, and artificial respiration applied; but when the doctor arrived he found life extinct. In answer to the Coroner, witness said that high pressure meant anything between 2,000 and 3,000 volts.

James Lamb, electrical cable jointer, said they were just on the point of finishing, and Sidney was putting some rubber tape over a connector, when he detected a slight leakage. Sidney was advised to put his rubber gloves on, and he did so for about a minute, but he then took them off, saying that he could not do his work properly and would take the risk. Appleton told him to leave it alone until he had telephoned to the works; but whilst he was away the arc light came on, and the deceased, who had his hand inside the pole, received the full charge of the current.

Edward Donoughue, electrical engineer, said he was in charge of the power station and went on duty at 4 o'clock in the afternoon. He was not informed that anyone was working at the cable in Abingdon Street, and at 7.30 o'clock in the evening, the usual time, he turned on the current, presuming that everything was clear. Five minutes later he received a telephonic message from Appleton saying that one of the men had received a shock, and he immediately switched off the current.

Herbert Thomas, electrical engineer, who was in charge of the station prior to Mr. Donoughue, stated that he was not aware that the men were working in Abingdon Street, and he had left no note for Mr. Donoughue when he (witness) went off at 4 o'clock. The note should have been given by the public lighting superintendent.

Richard Dagger, the public lighting superintendent, who gave his evidence under considerable emotion, said he had been at the Corporation electricity works 12 years. He knew that the men were working in Abingdon Street on Monday and visited them about 2.20 in the afternoon. At that time from what he could see, he did not think the job would last long, and never for a moment dreamt there would be any necessity for them to work overtime. Consequently, he left no note, as he should have done, with the engineer-in-charge, that the circuit should be kept clear.

The Coroner observed that it was a very sad case. They had had the man responsible before them and heard his explanation, and, it was evident feeling most acutely what had taken place. It was rather remarkable, he added, that Sidney should have persisted in going on with his work after detecting the leakage and without his gloves, after having been warned.

A verdict of "Death from Misadventure" was returned by the jury.

The Town Clerk, on behalf of the Corporation and the officials of the electricity department, expressed regret at what had happened, and sympathised with the deceased's relatives.

The Coroner associated himself with these expressions, and said he hoped that the man Dagger would suffer no ill consequences. The evidence pointed to the fact that the electricity works were carefully conducted, and never before had there been any accident of the kind. He hoped the Corporation would not look severely upon what had been a slip on the part of Dagger.

Death from Lead Poisoning.—An adjourned inquest was held at St. Helens on Peter Bridge (26) on 12th inst., deceased having been employed by the St. Helens Corporation, in connection with the electricity department. It was urged that the man had been suffering from lead poisoning, and he was paid compensation. Later, consumption made its appearance, and the medical man for the Corporation claimed that this was the sole cause of death. A *post mortem* examination had been held.

George E. Green, electrical mains foreman, said deceased had to clean and paint the street-boxes. On one occasion, when he and deceased were painting a sub-station, both felt the effects of the paint, and he offered to let the deceased smoke a cigarette, but he said he had given up smoking.

Mr. Chapman said before an employer was liable to pay deceased for lead poisoning, the injured person had to produce a certificate from the doctor, but that certificate had never been produced, and the Corporation were never under the obligation to pay anything at all.

The Coroner said it was strange that employers seemed always prepared to pay so much per week on the assumption that the man had received injuries entitling him to compensation, but when the man died and the relatives wanted a lump sum, the employers went back on the position they themselves had accepted.

Mr. Warr, who had charge of the electrical mains, said deceased

had to clean out the disconnecting boxes, and had to brush the inside of the box. A good deal of lead oxide accumulated on the cables in the box, and it would be easy for a man to inhale this, especially as he had to kneel down over the box.

Dr. Latham, Sick Club doctor for the men at the electricity works, said he found the man suffering from acute lead poisoning.

Dr. Judson (Manchester) agreed with the diagnosis after visiting the man, and he was seen by a chest specialist who went to report as to the probable duration of life, as the company wanted to commute the matter.

The Coroner: That is what they always want to do.

Witness explained that he found the man receiving compensation, and he was certain that lead poisoning accelerated death.

Other medical evidence was given to the same effect, and that the man was able to work up to the time that lead poisoning came on.

The Coroner (Mr. Brighouse) put certain questions to the jury, and they replied that death was accelerated by the lead poisoning, and that this was set up by the man's work for the Corporation.

Electro-Hydraulic Steering Gear.—Auxiliary or alternative steering gear of a type as yet new to steamships has been fitted by Messrs John Hastie & Co., Greenock, to the Orient liner *Orama*, in course of construction at the shipbuilding yard of Messrs. John Brown & Co., Clydebank. The gear has been in a more or less experimental form for almost a year on a steam yacht and is the Hele Shaw-Martineau patent electric hydraulic gear. It consists of two hydraulic rams working in cylinders on each side of the rudder stock and actuating the usual crosshead. The rams themselves are actuated by oil which is supplied from a rotary variable-stroke pump, which is itself driven by an electric motor alongside. The operation of the pump is controlled by a rod and lever connected with the rudder stock. According as the rod which enters the pump chamber is moved in or out from the central position, the oil is transmitted under pressure through one or other of the pipes connected to the ram cylinders. By the movement of this rod, therefore, the rudder head can be put over to port or starboard as required. The operation of the controlling rod or spindle is effected by means of the lever arrangement, which in turn is actuated by the telemotor from the navigating bridge. If the rudder is subjected to any shock, the rudder head yields by the transfer of oil from one ram cylinder to the other, the pump being automatically set in operation, and the rudder restored to the position corresponding to that of the steering wheel without the intervention of the steersman. In addition to the electric hydraulic gear which Messrs. Hastie & Co. have on hand for the Orient liner building at Clydebank, the firm have also gears of the new type on order for two Austrian Lloyd steamers building on the Continent, as well as several other large vessels.

Institution and Lecture Notes.—Institution of Electrical Engineers (Manchester Section).—The annual meeting was held on March 28th. Votes of thanks were accorded to the chairman and officers. The result of the voting for the committee for the next session was as follows:—Chairman, W. Cramp; vice-chairman, J. Frith; members, C. J. Beaver, A. A. Day, M. B. Field, G. Layton, Prof. E. W. Marchant, T. L. Miller, S. L. Pearce, Dr. E. Rosenberg, C. F. Smith, C. D. Taite, B. Welbourn and P. P. Wheelwright; past chairmen, Miles Walker, S. J. Watson and J. S. Peck; hon. secretary and treasurer, H. W. Wilson; assistant secretary and treasurer, A. L. Green. The committee's report showed that the Section numbered 500 members, and 269 students.

University of London, Goldsmith's College, New Cross, S.E.—Announcement is made of a series of summer evening classes to be held in the Engineering and Building Departments during May and June if there are sufficient entries. The subjects include drawing office practice for engineers and electrical engineers respectively, electric traction (lecturer, Mr. F. E. Kennard), fitting and machinery, reinforced concrete, &c.

Faraday Society.—At the meeting to be held on Tuesday, May 2nd, Mr. A. Scott-Hansen, the well-known Norwegian engineer, will deliver a lantern lecture on "Hydro-Electric Plants in Norway, and their Application to Electrochemical Industries." On the same evening, a paper is down for reading by Mr. Verdon Cutts, of Sheffield, entitled "Electrometallurgy in the Steel Foundry." The society meets at the Institution of Electrical Engineers, Victoria Embankment, W.C., and the secretary, Mr. F. S. Spiers, 82, Victoria Street, S.W., will be glad to send cards of admission to anyone desirous of attending the meeting.

Institution of Electrical Engineers (Students' Section).—The annual general meeting is to be held on Wednesday, May 3rd. The committee for next session will be elected by ballot at this meeting. Nominations for extra-collegiate candidates should be sent at once to the hon. sec., Mr. D. Betts, 3, Fordwych Road, London, N.W.

At the meeting of the Staffordshire Iron and Steel Institute at Dudley recently, a paper on "Electric Furnaces" was contributed by Mr. Verdon Cutts.

Electric Cabs in Berlin.—The end of the electric cab undertaking in Berlin has just been announced by the decision of the shareholders in the Berliner Elektromobil Droschken Gesellschaft to liquidate the company. At the recent meeting when a resolution to this effect was adopted, it was stated that the working of the cars had corresponded with the expectations at the beginning, and the daily receipts ranged from £2 10s. to £3 10s. per vehicle; but notwithstanding the large receipts, the company did not reach the stage of prosperity, as the working expenses were too high. The expenses were then reduced, but this action simultaneously brought about a decline in the receipts. In addition a larger number of cabs fitted with benzine motors was placed in service by competitive undertakings, and the public gradually withdrew the preference given to the electric cabs. The accounts to March 15th, without allowing for depreciation, show a deficiency of £77,000 on a share capital of £150,000. The withdrawal of financial support is declared to have rendered liquidation necessary.

Appointments Vacant.—Junior assistant engineers, for the Newcastle-on-Tyne Electric Supply Co., Ltd. (10s.); sales engineer (£200) and assistant construction engineer (£156), for the Yorkshire Electric Power Co.; assistant canvassing engineer, for the Borough Electricity Committee, Wolverhampton (£2); third-class clerk, for the Woolwich B.C. electricity department (£95). See our advertisement pages in this issue.

Inquiry.—A correspondent wishes to be put in communication with manufacturers of steel towers for high-pressure electrical transmission lines.

A Carnegie Hero.—Archibald McQueen, 69, Easter Road, Leith, has been presented with £10 from the Carnegie Hero Fund in recognition of a plucky act. McQueen, who was in the employment of an Edinburgh firm of electricians, was engaged in January last, along with other workmen, in carrying out alterations in connection with the electrical installation at Delvine House, Perthshire. By the exploding of a lamp a fellow workman, an electrician belonging to Edinburgh, was enveloped in flames, and rendered helpless. McQueen, at great risk, went to his assistance and extinguished the flames, being himself burned. Unfortunately, his comrade died as a result of the terrible burns he had sustained. Provost Malcolm Smith, Leith, who handed over the money to McQueen, spoke of his courageous act, and congratulated him on the honour which the Carnegie Hero Fund had bestowed upon him.

Trade Discount to Outsiders.—Referring to the letter under this heading in our issue of April 14th, Messrs. Hogan and Wardrop write stating that they are not the firm referred to in the letter.

Trade Statistics of Canada.—In these statistics, which are given on another page of this issue, the "Increase or decrease" columns require correction as follows:—

Manufactures of India-rubber and Gutta-percha.—Germany's increase should read 18,000, not 17,000 dollars.

Steam Engines.—U.S. increase, 21,000, not 11,000.

Machinery.—U.S. decrease, 203,000, not 103,000.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Whitehaven T.C. has decided to grant the borough electrical engineer, Mr. Sankey, an honorarium of £50 in respect of extra work in connection with the extension and renewal of plant. The Lighting Committee had recommended that Mr. Sankey's salary should be increased to a maximum of £300 by two annual instalments of £25 each, and the amendment in favour of the honorarium was carried by 9 votes to 8.

The Walsall Electricity Committee has appointed Mr. Ashton Bremner, M.I.E.E., late consulting and resident electrical engineer of Burslem, Staffs., as deputy engineer during the illness of Mr. Barnard, as arranged at the Council meeting. There were 31 applications.

The Bristol Sanitary Committee has appointed Mr. F. J. Barnes as superintendent of the destructor works, at a salary of £150 per annum, rising to £200.

Mr. F. E. Minchin, second assistant engineer at the Leek electricity works, has resigned.

Mr. W. P. Hooper, engineer-in-charge at the Doncaster Corporation electricity works, has been appointed to a similar post at Dewsbury, at £91, rising to £104 per annum.

Mr. F. Newey, of Kilmarnock, has been appointed shift engineer at Rawtenstall, in succession to Mr. H. F. Barnes, who has left to take up a similar appointment with the Great Northern Railway Co.

Mr. W. G. Crawford, district engineer for the Yoker area of the Clyde Valley Electrical Power Co., has been appointed mains engineer to date from January 1st, 1911, with headquarters at the head office, 53, Bothwell Street, Glasgow.

General.—According to the *Board of Trade Journal*, the New Zealand Government has decided to send Mr. T. Buckley, chief electrician of the Post and Telegraph Department, to England at an early date, to investigate the latest telephone practice.

M. Pierre Prier, who surprised the world by his wonderful aeroplane feat between Henlon and Paris last week, was, according

to the *Times*, born at Rouen, and is just over 24 years of age. He was a certified engineer at the Paris School of Electricity, which he left four years ago.

Obituary.—Mr. A. Schanschieff.—With feelings of the deepest regret we have learned of the death, which occurred at Chiswick suddenly on Sunday evening, of Mr. A. Schanschieff, at the age of 72 years. He was apparently quite well earlier in the day, having been out motoring in the morning and afternoon. After returning home in the evening, he complained of feeling unwell, and a quarter of an hour later he passed away. Mr. Schanschieff's interest in electrical matters consisted in a continuous and consistent enthusiasm for primary and secondary battery research and invention. For more than a quarter of a century we have known him and his work in this department with the fullest intimacy, and can testify to his zeal and tenacity, also to his delight when he was able to record some new advance. Like many another worker in the same field, he had many disappointments and set-backs, but he always seemed to be able to come up smiling again after awhile. He certainly merited a larger measure of success, as it is generally regarded, than fell to his lot. He was conspicuous for his conscientiousness and fairness, and his general sincerity and affability made him personally esteemed by all who met him. We, as editors, feel that we have lost in him one of our oldest friends in the electrical world, and in the various departments of the Electrical Review, where he had long been a welcome visitor, everybody will miss his characteristic and warm handshake. Mr. Schanschieff was born in St. Petersburg (Russia), was educated there, and entered the Russian Navy. Later he was commissioned by the Russian Government to inspect some rails which were being manufactured in this country for the Russian railways. He next turned his attention to the electrical field, and took out several patents for primary cells, his most successful being the single fluid mercury one concerning which a good deal was said in our pages about 25 years ago. This cell gave some excellent results, and it was reported upon very highly by both Lord Kelvin and Sir Wm. Preece. Mr. Schanschieff had the honour of exhibiting his invention before royalty. Regarding storage cells, his experience dates back to the days of Planté, whom he knew quite well, and in whose laboratory he worked. Later his thoughts were directed towards the Faure type, and he brought out several ingenious improvements and patents for grid supports and also active material. His attention at first was given to traction cells, and one of his achievements was the supplying of a battery to the first electric omnibus in London, which covered over 5,000 miles. He then supplied several batteries to the London Electric Omnibus Co. His improvement in this branch of electrical science was so satisfactory that at the present time some are still in use or being manufactured. In 1905 the deceased gentleman became associated with Mr. Hugo Stephens, and started making accumulators under the name of the Premier Accumulator Co., who have since installed a large number of batteries for central stations, country house lighting, &c., and eventually he resigned his position with the company about two years ago. The interment took place yesterday (Thursday) afternoon, at Chiswick. We desire to tender to his widow and family our very sincere sympathies with them in their bereavement.

Mr. J. Graves.—Mr. James Graves, who recently passed away at the age of 77 years, had been for very many years identified with submarine telegraphy, lately in the service of the Anglo-American Telegraph Co., Ltd. His personal estate is announced as £8,557.

Mr. C. W. Hunt.—The death is reported as having occurred on March 27th, at the age of 70 years, of Mr. Charles W. Hunt, president of the well known coal-conveyor, &c., business, the C. W. Hunt Co.

NEW COMPANIES REGISTERED.

Dettifoss Power Co., Ltd. (114,991).—This company was registered on March 30th, with a capital of £45,000 in £1 shares, to carry on the business of generators of power by means of water, heat, light, steam, electricity or otherwise, and to acquire certain property and rights from F. Hjorth, E. Benediktsson and A. E. Barton. Purchase consideration, £40,000 in cash. The subscribers (with one share each) are:—S. H. Borlian, Sutherland House, Surbiton, manager; T. A. Day, 72, Goldsmith Avenue, Manor Park, clerk; G. W. Parsons, 13, Brunswick Avenue, New Southgate, N., clerk; H. J. Langley, Braeside, St. Stephens, Hounslow, accountant; H. Uridge, Arbroath, Crescent Road, Bromley, Kent, clerk; K. G. Spratt, 2, Eversleigh Gardens, Loughton, clerk; J. Fleming-Yates, 33, St. James's Square, Holland Park, W., clerk. Minimum cash subscription, seven shares; the first directors (to be not less than two or more than seven) are A. E. Barton and H. E. P. Cottrell; qualification, £100; remuneration, £100 each per annum (£50 extra for the chairman). Registered office, Winchester House, Old Broad Street, E.C.

Dry-Glass Electric Fire Extinguisher Co., Ltd. (115,216).—This company was registered on April 11th, with a capital of £1,000 in £1 shares, to carry on the business indicated by the title. The subscribers (with one share each) are:—A. F. Carr, 20, Warwick New Road, Leamington, manufacturer; W. G. Oxley, High Street, Castle Bromwich, fire engineer; V. Campbell, 10, St. Stephen's Road, Leicester, manufacturers' agent. Private company. Table "A" mainly applies. Registered office, 39, Corporation Street, Birmingham.

Stairways, Ltd. (115,307).—This company was registered on April 13th, with a capital of £15 in 1s. shares, to carry on the business of makers, proprietors and conductors of electric and other lifts, stairways, elevators, escalators, moving stairways, tramways, railways and other mechanical appliances, &c. The subscribers (with one share each) are:—H. Hill, 41, Finsbury Pavement, E.C., journalist; S. Boyd, 17, Gracechurch Street, E.C., financial agent. Private company. The number of directors is not to be less than two or more than five; the first are T. Kipping, S. Boyd and H. Hill (all permanent). Registered office, 17, Gracechurch Street, E.C.

Player & Mitchell, Ltd. (115,270).—This company was registered on April 12th, with a capital of £15,000 in £1 shares, to take over the business of naval and railway brassfounders, lamp manufacturers, foghorn and log manufacturers and electric lighting contractors carried on at Cambridge Street, Birmingham, as Player & Mitchell, and to adopt an agreement with S. W. Mitchell. The subscribers (with one share each) are:—S. Sheppard, Scotia Works, Garrison Lane, Birmingham, brass cock manufacturer; W. Dampier, Scotia Works, Garrison Lane, Birmingham, brass founder; E. T. Kerr, 95, Colmore Row, Birmingham, incorporated accountant; S. W. Mitchell, Cambridge Street, Birmingham, brassfounder; T. W. Marshall, 3, Newhall Street, Birmingham, solicitor. Private company. The number of directors is not to be less than two or more than four, the first are S. Sheppard and W. Dampier (both permanent). Registered office, Attwood Passage, Cambridge Street, Birmingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Direct United States Cable Co., Ltd. (11,597).—Return dated February 7th, filed February 17th. Capital £1,300,000 in £20 shares; 60,710 shares taken up; £1,214,200 paid. Mortgages and charges: Nil.

Rhondda Tramways Co., Ltd. (88,415).—Particulars of £200,000 first debentures, created March 13th, and secured by trust deed dated March 24th, 1911, filed pursuant to Sec. 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: Tramways and right of user of same and levying tolls, rates, fares and charges in respect thereof, and lands with generating station, car-sheds, offices and buildings thereon, and other premises comprised in lease with Rhondda Urban District Council, together with all equipment of or used in connection with the tramways and generating station, and all purchase-moneys to be received from such Council upon the expiration of the said lease, and the company's undertaking and property, present and future, including uncalled capital. Trustees, Law Debenture Corporation, Ltd., 41, Leadenhall Street, E.C.

Central Electric Supply Co., Ltd. (53,080).—Return dated February 14th, filed February 21st, 1911. Capital £100,000 in £5 shares. All shares taken up; £100,000 paid. Mortgages and charges: £450,000 guaranteed debenture stock.

Landaulet Co., Ltd. (formerly Electric Landaulet Co., Ltd.) (72,890).—A memorandum of satisfaction in full on March 30th, 1911, of debenture dated March 8th, 1910, securing £4,000, has been filed. Debenture dated March 30th, 1911, to secure £6,000, charged on the company's undertaking and property, present and future, including uncalled capital, has also been registered. Holder: F. W. Stanley, 131, Westbourne Terrace, W.

Carmarthen Electric Supply Co., Ltd. (105,409).—Issue on March 25th of £50 debentures, part of a series of which particulars have already been filed.

Oriental Telephone and Electric Co., Ltd. (40,691).—A memorandum of satisfaction to the extent of £2,350 on February 15th, 1911, of trust deed dated June 28th, 1905, and acknowledgment of indebtedness dated June 12th, 1907, securing £200,000 debenture stock, has been filed.

Telephone Co. of Egypt, Ltd. (17,824c).—A memorandum of satisfaction to the extent of £1,145 on March 29th, 1911, of trust deed dated July 27th, 1904, and three acknowledgments of indebtedness dated February 21st, 1906, March 4th, 1908, and October 27th, 1909, securing £200,000 debenture stock, has been filed.

Cowper-Coles Engineering Co., Ltd. (102,724).—Issue on February 27th of £300 debentures, part of a series of which particulars have already been filed.

Midland Electric Manufacturing Co., Ltd. (100,921).—First mortgage debenture dated March 17th, 1911, securing £1,000, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: F. H. Jordan and J. H. Prince, both of 74, Temple Row West, Birmingham.

CITY NOTES.

Oriental Telephone and Electric Co., Ltd.

The directors' report for the year ended December 31st last states that, including £10,529 brought forward from December 31st, 1909, and after deducting the interim dividends of 3 per cent., paid November 1st last, on both the preference and ordinary shares, and making the necessary provision for redemption of the debenture stock of the company, and other charges as shown in the net revenue account, the amount to be dealt with is £37,065. The directors recommend that this sum be appropriated as follows, viz.: Final dividend of 3 per cent. (less income-tax) for the year on the preference shares issued, £1,500; final dividend of 5 per cent. (free of income-tax) on the ordinary shares issued, making 8 per cent. for the year, £8,966; transfer to reserve account, £7,500; to reserve for contemplated staff pension scheme, £1,000; carrying forward £18,100. The revenues at the various centres of the company's operations exhibit increases in every instance, and the same may be said of the subsidiary companies. The Bombay Telephone Co., Ltd., has increased its dividend from 7 to 8 per cent., but the Telephone Co. of Egypt, Ltd., the Bengal Telephone Co., Ltd., and the China and Japan Telephone and Electric Co., Ltd., continue to pay their previous rates of 10, 5 and 5 per cent. respectively, owing to their heavy capital requirements. The concession to extend the telephone service over the whole of the Island of Mauritius, where practicable, has now been granted to the company by the Government of Mauritius, and is being prepared for signature. It is for a term of 30 years, and the construction of the necessary lines inland will commence as soon as the document is completed. It is expected that these lines will tend to add to the number of subscribers at Port Louis, the chief town and seaport, which is at present the company's only telephone centre in the island.

Babcock & Wilcox, Ltd.

The directors report that the net profit during the year 1910 amounted to £362,360, plus £63,083 brought forward, making a balance of £425,443. The interim dividends paid October 10th, 1910, of 3 per cent. on the preference shares, and of 10 per cent. on the ordinary shares, amounting to £86,000, leave a balance of £339,443, from which the directors recommend that the following dividends be paid for the half-year ending December 31st, 1910, viz. :—Dividend of 3 per cent. on the preference shares (from which income-tax is to be deducted), £3,000 ; dividend of 8 per cent. on the ordinary shares (free of income-tax), £66,400 ; bonus of 8 per cent. on the ordinary shares (free of income-tax), £66,400 ; placing to the reserve fund £100,000 (which will bring this fund up to £700,000) ; placing to the dividend equalisation fund £25,000 (which will bring this fund up to £245,000) ; placing to the staff pension fund £10,000 ; and leaving a balance to be carried forward of £68,643. The volume of the company's business during last year showed an increase, but competition and increased cost of labour and materials reduced the ratio of profit. The turnover is, however, so large as to give a good return on the capital of the company, notwithstanding relatively low rates of profit on the orders. The demand for the company's marine boilers for naval work has been satisfactory, and their use in the mercantile marine continues to show progress. Amongst important orders in hand in this respect may be noted the boilers for the S.E. and C. Railway Co.'s new cross-channel steamers *Riviera* and *Engadine*, which are being built by Messrs. Denny, of Dumbarton ; and several mail steamers for Australia, &c. In view of the application of crude oil engines for marine propulsion, the company has acquired a general licence for the British Empire to use the patents and experience of the Maschinenfabrik Augsburg Nurnberg, a firm who have made the greatest advance so far in this direction. The company is consequently in a position to take advantage of this development should the future require it. The company's works have been well maintained, and the buildings have been extended, and many improvements carried out ; amongst others, the construction of their own water-works. It is proposed to make the same provision for the staff pension fund as was made last year.

Willans & Robinson, Ltd.

Mr. J. C. Peache presided on Tuesday, April 11th, at the Cannon Street Hotel, E.C., over the thirty-fourth half-yearly meeting.

The Chairman, in moving the adoption of the report (see Electrical Review, page 562), said he had to express the regret of the directors that the accounts again showed an adverse balance. The cause of recent losses was the deplorable condition of the electrical trade during the last two years or more. There had not been sufficient work to more than partially supply the requirements of manufacturers. Consequently there had been the keenest competition and prices had dropped to a ruinous extent. Compared with the prices obtainable for turbine plant three years ago the price obtainable to-day showed a drop of about 30 per cent., and, on the other hand, there had been a considerable rise in the rates of wages during the period under review. The electrical industry in this country had also during the last year or two suffered severely from unrestricted or even bounty-fed Continental competition. Out of the limited number of orders available, time after time their Continental competitors had stepped in and had taken the work at prices that did not represent transactions on a commercial basis, but constituted a persistent attack on the electrical trade of this country. Concerns which had been able to accumulate reserves could, without difficulty, meet a lean time like the present. The misfortunes which had befallen their company had left no such resources for meeting the present time of adversity. Although the situation was one to cause anxiety, yet it was by no means a hopeless one. There was a balance of investments unsold. There was a cash balance at the bank, and there had at no time been an overdraft. The shops were fairly well supplied with orders, and although, as pointed out, these orders had had to be taken on a low scale of prices, yet the returns to be made on this work if not yielding an actual profit, would be sufficient to provide for the carrying on of the business. At a meeting of the company held in November last increased borrowing powers were granted to the board. So far these powers had remained in abeyance, no necessity having arisen to call for their exercise. Notwithstanding the absence of profit, the directors had considered it right to adhere to the very liberal provision for depreciation which had been traditional in the history of the company. This was as fully provided for to-day as at any period of the company's history. The full figures were not now shown in the balance-sheet, because a number of items which used formerly to be charged against capital account, and subsequently depreciated, were now charged direct against manufacturing profit. The option for the purchase of Queen's Ferry Works which ran to November of last year was not taken up, and the option money had been credited to the profit and loss account. Negotiations for the disposal of this property were, however, still in progress, and there was a fair prospect of their being completed in the near future. The possibility of amalgamation with another concern had been spoken of at previous meetings. Serious negotiations were now in progress. These negotiations might mature into a definite proposition. Should this be so, and provided the terms obtainable were such as the directors could recommend for acceptance, meetings of the debenture holders and shareholders would be called and the scheme submitted for their ratification. Allusions was made in April of last year to certain outstanding liabilities, and in October one of these liabilities—a lawsuit in which the company was involved—was specifically alluded to. At the time, in view of the matter being *sub judice*, it was not possible to deal with the subject, and, indeed, it was not possible for the same reason to do so to-day. For although the hearing of the case was commenced in the autumn of last year, there had been a number of adjournments, and judgment had not yet been delivered. Under these circumstances, therefore, he was at present precluded from entering into a discussion of the case. The figures in the balance-sheet and profit and loss account were, as usual, set out in considerable detail. He did not at this point propose to take up the time of the meeting in further analysing those figures, but he would be ready later on to deal with any points on which shareholders might wish to have further information. It was not necessary for him to do more than briefly allude to the proposed changes in the management of the company as set out in the report. These had been very carefully considered by the board, and were commended as effecting a material reduction in the outgoings without impairing efficiency. He would like to take this opportunity of saying that the appointment of Mr. Davenport had been of the greatest value to the company. A year ago he spoke of the courage shown by Mr. Davenport in joining the company at a time when its prospects were much overshadowed, and since then his colleagues and himself had had reason to be grateful for his unfailing courage in dealing with the difficulties by which it has been beset throughout the year. In commending him now for the position of managing director they acted with absolute confidence, for they knew that in Mr. Davenport they had a man of first-class ability and energy, and that he could be trusted to manage the business wisely and well.

Mr. T. R. Davenport, in seconding, said he should endeavour to justify as far as possible the views generously expressed by the chairman for the future. As regarded the business itself, the company continued to secure its fair share of all work given out, and although the market prices remained deplorably low, they had every hope that the substantial economies recently effected would assist materially in discounting the same. They were satisfied that these economies were being made without material loss of efficiency, aided as they were by a loyal and very hard-working staff. Their reputation for high-class work was well maintained, and their list of clients remained the best proof of this. He might, perhaps, say that they were engaged now on the largest land turbine plant so far ordered in this country, which was secured amidst keen competition as regarded design as well as price. He should allude also to the Diesel oil engine work which they were now quite free to handle energetically, and mention that the business so far entrusted to them promised well for the future. The chairman had already referred to the question of association with another concern which was engaging close attention at present, so he need only add that their belief in some such arrangement remained unshaken, bearing in mind their primary duty of protecting the shareholders' interests. It was gratifying to have so far dispensed with the special borrowing powers given them at the last meeting, though for their general trade and credit purposes it was advisable to have these at hand. The disappointment which shareholders must of necessity feel from their holding point of view was fully shared by the directors themselves, who were all financially interested, and two of them (Mr. Peache and Mr. Anderson) perhaps more deeply so than any other holders. Before concluding, he would like to say that Mr. Peache's wish to take a less active part in the company was one that they most reluctantly acceded to, and he knew the shareholders would endorse the great regret they felt at losing his active efforts on their behalf. His services had been fearlessly and earnestly rendered during several years of difficulty, and they were grateful to be in a position to commend him for the vacant post of chairman, where they would still have readily available his valuable advice and counsel.

Mr. F. W. Clark said that some years ago the chairman was introduced to take the management of the concern, and now it was said he wished to retire. No reason was given for such a step, and he considered it was due to the shareholders that a reason should be given. Mr. Peache was introduced as a man of exceptional experience and ability to take on the captainship, and they ought to know why he was retiring. He suggested some years ago that the company should take up other lines, such as engines connected with motors, or something of that kind, but they were apparently going on in the same groove, and doing business that was unremunerative.

The Chairman said if he was to say anything about his retirement, beyond that stated in the report, it was that having acted as managing director, he had, perhaps, felt the condition of things more than anyone else, and although his honest opinion was that this state of affairs was due to the force of circumstances, still, as the company had gone down under his captainship, he felt it would be only fair for someone else to take his place. If he was elected chairman, it would be his constant interest to do all he could on behalf the company. As to taking up other lines of business, they had done so, but any new line taken up meant a matter of time before it could become profit-earning, and it was easy to go too far in that direction, and lose money.

Mr. Harrison deplored the painful monotony of the reports, and said he thought there had been too much chopping and changing amongst the directorate. Mr. Peache had gained ripe experience at the expense of the shareholders, and it seemed to him very detrimental to the company that this experience should be thrown away. It seemed to him there had been too much attention paid to the supervision of the accounts and too little to the technical details of the business. As a small shareholder, he asked the chairman to reconsider his determination to retire from the managing directorship.

Mr. Willard also expressed disappointment at the proposed change, and thought if Mr. Peache had kept more to the engineering

side, his rule would have been more successful. It looked as if Mr. Peache looked upon this as the end of matters. He moved the adjournment of the meeting, in order that the board might bring up a more reasonable report.

The amendment found no seconder.

The Chairman said that during the seven years he had been at Rugby a very competent technical staff had grown up, and he did not think the works would lose anything from the technical point of view from his giving up the technical work at this juncture. Anything he had been able to do would be carried on equally efficiently by the technical staff at Rugby, under the able supervision of Mr. Davenport.

The report was then adopted.

Capt. Sankey proposed a hearty vote of thanks to Mr. Peache for his work, and said he personally greatly sympathised with him in the state of the company.

Mr. Cousins, who seconded, said it had been remarked that Mr. Peache thought this was the end of things, but he was quite certain Mr. Peache would not give up his responsibilities at such a juncture if he thought such was the case.

The Chairman briefly acknowledged the vote.

The retiring director was re-elected, and the meeting closed with a vote of thanks to the board and staff.

Stratford-on-Avon Electricity Co., Ltd.

The directors' report for the year ended December 31st, 1910, states that there has been a very satisfactory increase in the demand for electricity, as shown below, and this increase is reflected in the accounts. After writing off £175 to reserve and depreciation account, the net revenue account shows an available balance of £390, which the directors recommend should be appropriated as follows:—To building sinking fund, £15; to payment of a dividend at 2 per cent., £140; to payment of directors' fees, £50; balance carried forward, £185.

	1908.	1909.	1910.
Units generated	71,340	102,845	128,011
Units sold	43,551	77,055	98,289
Lighting	17,451	33,456	43,889
Power	23,345	39,710	45,128
Heating	2,755	3,889	9,272
Used on works	20,089	19,240	22,604
Unaccounted for	7,700	6,550	7,118
8-c.p. lamps connected	6,496	8,456	9,605
Max. load in kw.	76	75	87
Average price obtained	3·03d.	3·04d.	3·13d.

Dudley, Stourbridge and District Electric Traction Co., Ltd.

Mr. S. R. Blundstone, presiding on April 10th at the offices, 1, Kingsway, over the meeting of this company, said that the profit and loss account showed disappointing results, there being no profit available out of which to pay a dividend on the ordinary shares. This was the first time of late years that profits had not enabled the directors to recommend the payment of a dividend on the ordinary stock. There were several reasons for the falling off of the company's profits, amongst the chief of which might be mentioned a decline of £400 in the traffic receipts, due principally to the adverse traffic conditions, such as the bad weather which prevailed throughout the year, and partly to the unpopularity of the new system of fares which was introduced on January 1st, and which was designed, as he mentioned last year, to give increased travelling facilities to the public, and at the same time improve the earning powers of the tramways. The fare system had now been modified where necessary to suit the local conditions, and was working satisfactorily. A further shrinkage of the company's receipts had arisen from the fact of the purchase of the Kinver Light Railway, and the payment to the Birmingham and Midland Tramways, Ltd., of £59,000 therefor. Of this amount there was on deposit with the Birmingham and Midland Co. during the greater part of the previous year £40,000, and the interest arising on this sum amounting to £1,470, came into the profits of the year. In order to complete the purchase it was necessary to arrange for an overdraft of several thousands of pounds, and the interest on this, £960, was charged in the accounts. These items made a difference of £2,400 between the profits of the year, but, on the other hand, the profits arising from the working of the Kinver Light Railway would now come to the company. Another important cause for the reduction of profits was the increasing cost of maintenance of permanent way and rolling stock. It must be remembered that the rolling stock had now been in use for 10 or 12 years, and a large number of cars had had to be almost rebuilt. The wear on the cars was very excessive in some parts of the district, owing to the frequent damage done to the permanent way through mining subsidences. Not only was the cost of maintaining the track more than it should be on an interurban tramway of that nature, but the cost of the repairs to the rolling stock was also more, on account of the severe treatment it received on the road. In addition to the large expenditure which had been charged to repairs account, the sum of £2,342 had been charged against the renewal account, whilst this fund had been further credited from revenue with £600. The result was that after placing £600 to renewals, and £600 to depreciation and reserve accounts, and £300 to sinking fund, there was only a balance of £161 left, as compared with £2,012 in the previous year. With regard to the arbitration to determine the price to be paid to the Dudley Corporation for electricity for working the tramways in Dudley, he could only say that the arbitration extended over five days and cost a great deal of money, and it was to be regretted that a conclusion of any difficulty of this kind with a local authority did not seem to be possible by agreement without resorting to arbitration, and this threw an enormous tax on a tramway undertaking. The arrangement with the Joint Committee had been renewed, as it had been found that the operation of the company's undertaking by a Joint Committee as part of the tramway system of the Black Country had been attended with satisfactory results, and the company obtained the benefit of the economy in the management which would otherwise not be possible.

Mr. J. A. Lycett (managing director) seconded the motion, and it was agreed to without discussion.

	1909.	1910.
Miles open—		
Route-miles	20·82	20·82
Single line..	13·86	13·86
Double line	6·96	6·96
Passengers carried	7,050,904	6,750,703
Average receipts per passenger	1·43d.	1·50d.
Average working expenditure per passenger..	·93d.	1·00d.
Proportion of expenses to receipts	70 %	74 %
Cars in stock	60	60

Hindhead and District Electric Light Co., Ltd.

The directors' report for the year ended December 31st, 1910, which was adopted at the meeting held on April 12th, states that during the year mains have been laid from the Hindhead generating station to Haslemere, by two routes, divided by disconnecting pillars into six sections, so that, in the event of an accident, only the lights of one section will be affected. Electricity is now supplied from Grayswood Common to Bramshott Common, and from the golf links to Blackdown. The pillar at "Courtfield" is designed to connect a future extension to the Fernden and Marley Heights Estates, Fernhurst, and North Ambersham. In accordance with the terms of the Provisional Order it is purposed this year to extend the mains to Shottermill Ponds and "Seven Thorns." The company has also to supply Frensham within four years, but is prepared to consider applications from Churt and Frensham in the hope that they may be sufficiently numerous to justify laying mains throughout these parishes in 1912. The directors have secured the option to purchase land at Clay Hill, adjoining the railway siding, admirably adapted for the erection of a sub-station when needed. Since June last there has been on this site a temporary office and an iron kiosk in telephonic communication with the central station. With the consent of the Board of Trade, and by agreement with the Hambledon Rural District Council, the company has liberty to suspend the supply of electricity from dawn to dusk, but as consumers found that this was inconvenient to them, the mains were kept charged day and night during the past winter. The net profit—after deducting debenture interest, the interim dividend at the rate of 2½ per cent. paid in June last, and income tax—amounts to £1,700. The directors recommended that this should be appropriated as follows:—Add to depreciation account £756 (increasing this to £6,949), write £100 off goodwill account, pay a dividend of 3½ per cent. for the half-year ended December 31st, 1910 (making a total dividend for the year of 6 per cent.), and carry forward the balance £282. (The dividend for 1909 was at the rate of 5½ per cent. per annum, and £204 was carried forward.)

Calcutta Tramways Co., Ltd.—The directors' report gives the following results for the year ended December 31st:—Receipts: Calcutta, £179,421; Howrah, £7,085; total, £186,506. Working expenses: Calcutta, £100,290; Howrah, £6,064; total, £106,355. Revenue balance: Calcutta, £79,130; Howrah, £1,020; total, £80,151; balance brought forward, £435; total, £80,586. Interest on debenture stock and bank advances, dividend on preference and ordinary shares paid and expenses share issue account written off, require £46,842, leaving an available balance of £33,743. The directors propose to pay a final dividend of 3s. 6d. per share, making 6 per cent. for the year, £24,081; adding to the depreciation fund £8,000, and carrying forward £1,661. The depreciation fund at the commencement of the year stood at £55,941. After adding thereto £1,790, interest on investments, and £8,000 proposed to be allocated, as above, and deducting £6,128 written off for renewals during the year, the fund will stand at £59,602. The traffic receipts amount to £184,913, against £174,367 for 1909, or an increase of £10,546, whilst the expenditure shows a decrease of £1,323. The report refers to the steady expansion of the business, which again shows a record in receipts, and to the fact that it has been possible, in spite of the larger business, to reduce the outgoings. At the same time, owing to the facilities afforded by the new car-shed added last year, the condition of the rolling stock has been greatly improved, and has never been better than at present. As regards the extensions, those in Calcutta are now almost equal in value to the original system, and the Howrah lines continue to improve.

Telephone Co. of Egypt, Ltd.—The directors have declared a dividend of 6 per cent. (6s. per share), free of income-tax, on the preferred and deferred shares for the half-year to December 31st, making 10 per cent. for the year.

France.—La Compagnie Française pour l'Exploitation des Procédés Thomson-Houston, of Paris, reports a profit of £155,130 for the last financial year, as compared with £146,357 in the preceding 12 months.

Indo-European Telegraph Co., Ltd.

The directors report that the company's traffics continue to show a gratifying increase, and have been carried with the accuracy and speed rendered possible only by the use of direct Wheatstone working over the whole system, particularly between London and Karachi. An additional allocation is proposed in the accounts towards the cost of increasing the carrying capacity of the system. The question of additional cross-Channel cable communication is still occupying the attention of the directors. The company's revenue from message account and other sources, as shown in the revenue account, amounts to £155,549, as compared with £145,604 for 1909, showing an increase of £9,945. The expenses are, on commercial and general account, £53,848; and on maintenance account, £27,021; making a total of £80,869; as against £78,296 for 1909, showing an increase of £2,573. This, however, includes a special bonus of £3,406 voted by the directors to the commercial and maintenance staffs. The revenue account, therefore, shows a balance of £74,680, which is carried to profit and loss account, 1910, and after deduction of income-tax paid is reduced to £70,477. To this is added the balance of profit for 1909 brought forward of £7,978, making a total of £78,455. The sum of £4,628 has been provided to meet the depreciation of the company's securities to date. Deducting this sum and the interim dividend of £10,625 already paid, there remains a balance available for distribution of £63,202. The directors now propose to declare a dividend for the six months ending December 31st, 1910, of 17s. 6d. per share (making with the interim dividend already paid 6 per cent. for the year) and a bonus of 20s. per share, both free of income-tax, and to make a special distribution to the shareholders of £12,750, equivalent to 15s. per share, out of interest upon certain investments and advance accounts. This distribution, also, will be free of income-tax. They also propose to set aside the further sum of £20,000 towards the cost of increasing the carrying capacity of the system, carrying forward £11,327 to the credit of 1911.

Bromley (Kent) Electric Light and Power Co., Ltd.—The annual meeting was held at Bromley recently, Mr. F. E. Gripper presiding. The chairman said that the report of the year's working was satisfactory, the lamp connections having increased very substantially. They had added 6,000 lamps, against 5,000 in 1909, and with new consumers they were maintaining their output of electricity, for in spite of the smaller consumption of the metal lamp, the actual sale of current had slightly increased. The current sold had practically been stationary during the last three years. The metal lamp had been an extremely good friend to them. It had enabled them to hold their own, and but for it they would have been in a much worse position than they now occupied. The capital account had been increased by only £590 for new services and meters. Revenue from sale of current was £133 better than last year, but working costs increased by £554, due almost entirely to increased rates and taxes. They had made a larger profit on wiring, and were receiving a larger return on their investments in the Chislehurst company—4½ per cent., instead of 3 per cent. They were pleased to be able to recommend ½ per cent. more dividend—namely, 6 per cent. for the year. Mr. Medhurst seconded the adoption of the report, and the motion was carried.

Siam Electricity Co., Ltd.—The *Bangkok Daily Mail* for March 1st contains an account of the meeting of this company, at which Mr. A. Westenholz presided. The report, which was adopted, showed the gross profits for 1910 at Ticals 1,188,711, and the net profit, after allowing Ticals 403,296 for depreciation, also debenture interest and other charges, at Ticals 622,611. To redemption fund there was then placed Ticals 20,000, to contingencies fund Ticals 33,065, directors' fees Ticals 22,109, dividend 12 per cent. on 35,000 shares of £10, Ticals 392,500, bonus for 1910, 6 Ticals per share on 25,000 shares, Ticals 150,000, carrying forward Ticals 4,905. At the end of the year Mr. Westenholz retired from the managership of the company, and Mr. W. L. Grut was appointed in his place.

Grassington (Yorks.) Electric Supply Co.—At the meeting of the shareholders held at Skipton, the chairman (Mr. John Crowther) said the company had lately been passing through difficulties. In consequence of unforeseen circumstances the expenses had been much larger than had been anticipated at the beginning of the financial year. In order to complete the thousand £1 shares it was necessary that the 127 not yet taken up should be spoken for. A statement by the engineer showed that the company had an ever-increasing demand for current. Several houses near the station were requiring electric installations, the officials in connection with the new police station had been making inquiries as to the supply of current, and it was fully expected that the proposed new sanatorium which the Bradford Corporation intended to erect would require both light and heat.

Newcastle-Emlyn and District Electric Supply Co., Ltd.—The annual meeting was held at Newcastle-Emlyn. Dr. J. Powell, who presided, said that the company stood on a favourable basis, but they were not yet able to declare a dividend. The balance-sheet showed a revenue for supply of current of £234, and, in addition there was a sum of £58 outstanding. There was a feeling amongst the shareholders to increase the capital, with a view to buying accumulators, so as to reduce the working expenses.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in:—

Minnesota and Ontario Power Co.—$500,000 6 per cent. first mortgage gold bonds, Nos. J 4,761 to 4,900 for $500 each, 1922; J 1,471 to 1,700 for $1,000 each 1922; K 4,951 to 5,100 for $500 each, 1923; and K 1,791 to 1,915 for $1,000 each 1923.

And to allow the following securities to be quoted in the Officia List:—

Lima Light, Power and Tramways Co. (Las Empresas Electricas Asociadas)—£1,188,300 5½ per cent. first mortgage debentures, in lieu of the scrip.

The Committee has appointed a special settling day as under:—

Thursday, April 27th.—Canadian General Electric Co., Ltd.—Further issue of $726,200 Common stock, in shares of $100 each.

And ordered the undermentioned to be quoted in the Official List:—

Canadian General Electric Co., Ltd.—Further issue of $726,200 Common stock in shares of $100 each.

Waste Heat and Gas Electrical Generating Stations, Ltd.—160,000 shares of £1 each, fully-paid (Nos. 1 to 160,000).

Kidderminster and District Electric Lighting and Traction Co., Ltd.—The directors' report states that the profit and loss account for the year ended December 31st shows that the gross receipts, including the dividend on the shares held by this company in the Kidderminster and Stourport Electric Tramway Co. amounted to £9,599. Including £87 brought forward there is a total of £9,686, compared with £9,252 for 1909. After deducting all expenses, including debenture stock and other interest, there remains £4,222. The directors propose to place to depreciation and renewals fund, £1,175; to debenture and loan redemption reserve, £250; to dividend on cumulative preference shares for 1910, £1,500; to dividend at the rate of 2½ per cent. per annum on the ordinary shares, £1,175; leaving to carry forward, £122. The gross receipts of the Kidderminster and Stourport Electric Tramway Co. amounted to £6,043, an increase of £178, and the expenses, before providing for renewals, to £3,288, a decrease of £61. The profit, after providing for renewals, is £2,385, which, added to the balance of £32 brought forward, leaves an available balance of £2,418. This amount has been applied thus: reserve fund £250; to dividend at the rate of 3½ per cent. on 5,720 shares £2,002; leaving to carry forward, £166.

Bude Electric Supply Co.—The *Financial News* states that this company, which paid 5 per cent. at the end of the first full year, has paid 6 per cent. at the end of the second, and is strengthening its position by writing down the preliminary expenses and building up a good depreciation fund.

South Metropolitan Electric Trams and Lighting Co., Ltd.—The directors have declared a dividend of 6 per cent. on the preference shares for the year to December 31st, 1909, placing £2,500 to depreciation and reserve, £2,000 to renewals, and carrying forward £339.

British Columbia Electric Railway Co., Ltd.—The directors have declared an interim dividend at the rate of 8 per cent. per annum on the deferred stock in respect of the half-year to December 31st.

Bell's United Asbestos Co., Ltd.—The directors recommend a balance dividend of 1s. 6d. per share, making a total of 12½ per cent. for the year. £16,122 is carried forward.

Direct United States Cable Co., Ltd.—The board have resolved upon the payment of an interim dividend of 2s. per share, free of income-tax, being at the rate of 4 per cent. per annum for the quarter ending March 31st, 1911, payable 26th inst.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended February 21th, 1911, were 526,960, compared with 439,285 units in the corresponding four weeks of 1910.

Kalgoorlie Electric Power and Lighting Co., Ltd.—The directors have declared a dividend on the preference shares at the rate of 6 per cent. per annum for the six months ended March 31st, 1911, payable April 27th.

Hastings and District Electric Tramways Co., Ltd.—An extraordinary meeting was held on Wednesday at the offices, for the purpose of confirming the resolution passed on April 4th for the reduction of the capital. The effect of the resolution is to reduce the capital from £341,175 to £214,117. The resolution was adopted.

River Plate.—An exchange states that the directors of the Pergamino Electric Light Co. have declared a dividend of 10 per cent.

Held Over.—Pressure upon our space compels us to hold several City matters over until next week.

Kaministiquia Power Co.—The directors have declared a quarterly dividend at the rate of 3 per cent. per annum.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Route miles open. Inc.
Aberdeen	April 12	2,560	+ 40	45	62,585	+ 1,129	..	..
Ayr	„ 15	429	+ 21	48	13,740	+ 352	8	..
Bath	„ 14	8,371	— 38	15	9,771	— 720	..	..
Belfast	„ 16	2,088	+ 56	2	2,398	— 34	13·7	..
Birkenhead	„ 8	14,006	+ 147	..	..	..	56·7	..
Birmingham Corp.	„ 16	2,001	+ 125	2½	2,510	— 502	14·6	..
Blackburn ..	„ 13	1,053	— 74	2	1,052	— 3	..	..
Blackpool Corp. ..	„ 8	283	— 86	..	3,509	— 977	..	..
†Blackpool-Fleetw'd	„ 9	4,532	+ 26	..	..	..	26	..
Bolton	„ 12	2,880	— 245	1½	2,355	— 461	21·9	..
Bournemouth ..	„ 8	9,659	—1,537	..	..	..	54·8	..
Bradford	„ 16	1,782	+ 145	2⅔	2,000	+ 10	9·5	..
Brighton	„ 14	11,379	+ 407	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	„ 7	406	— 27	14	2,920	— 34	3·65	..
Barnsley	„ 7	350	— 15	„	2,361	+ 11	..	..
Barrow	„ 7	482	+ 2	„	3,185	+ 49	5·37	..
Cavehill	„ 7	146	— 143	„	863	— 143	..	..
Devonport	„ 7	862	— 29	„	5,849	+ 291	8·85	..
Gateshead	„ 7	1,982	+ 22	„	13,684	+ 536	11·25	..
Gravesend	„ 7	359	— 77	„	2,489	— 155	6·5	..
Greenock	„ 7	1,327	+ 44	„	8,364	+ 1,180	7·25	..
Hartlepool	„ 7	430	— 93	„	2,919	+ 75	6·72	..
Kidderminster ..	„ 7	167	— 74	„	1,141	— 53	..	..
‡Leamington	„ 7	286	— 86	„	1,802	— 204	..	..
Merthyr	„ 7	379	— 87	„	2,528	— 105	2·9	..
Metropolitan ..	„ 7	15,412	— 294	„	105,110	+11,694	22	..
Middleton	„ 7	672	— 173	„	3,884	+ 58	8·5	..
Mid. Joint Com'tee	„ 7	11,118	—1,080	„	77,941	+ 1,474	..	..
Oldham—Ashton	„ 7	1,061	+ 206	„	7,149	— 183	9·13	..
Peterborough ..	„ 7	202	— 80	„	1,371	+ 16	5·31	..
Potteries	„ 7	3,864	+ 379	„	25,935	+ 2,500	29	..
Rothesay	„ 7	137	— 324	„	628	— 326	2·75	..
Southport	„ 7	471	— 218	„	3,124	— 205	8·17	..
S. Metropolitan ..	„ 7	1,349	— 421	„	9,341	— 701	..	..
Swansea	„ 7	2,066	— 62	„	14,249	+ 788	12·5	..
Tynemouth	„ 7	294	— 177	„	2,022	— 121	3·75	..
Weston-s-Mare ..	„ 7	53	— 188	„	283	— 279	3	..
‡Worcester	„ 7	457	— 182	„	3,168	— 160	5·75	..
Wrexham	„ 7	198	— 17	„	1,223	— 18	..	..
Yorks. Wool. Dist.	„ 7	1,937	— 199	„	13,525	+ 713	17	..
Miscellaneous ..	„ 7	388	— 74	„	2,626	— 22	..	..
							11·73	1
Burnley	„ 15	2,962	+ 590	..	..	..	6·62	..
Burton-on-Trent ..	„ 16	507	— 5	2	578	+ 6	22·5	..
Bury	„ 9	2,233	— 26	1½	1,554	— 3	..	..
†Cardiff	„ 8	2,091	+ 129	..	..	..	..	..
Carlisle	..	..	..	..	..	..	..	..
†Chatham and Dist.	„ 6	728	— 26	14	10,209	— 461	14·9	..
†Cork	„ 6	459	+ 5	14	5,877	— 169	9·89	..
Croydon	Mar. 31	3,043	— 462	..	85,807	+ 2,717	11·25	..
Darlington	April 9	387	+ 12	..	..	..	..	..
Darwen	„ 7	463	— 30	..	..	..	4·36	..
Dover	„ 8	338	+ 5	..	..	..	4·75	..
Dublin	„ 14	10,171	— 165	..	74,248	— 599	54·2	..
Dundee	„ 12	2,259	— 94	17⅔	56,052	+ 211	15	..
†East Ham	„ 8	999	— 30	1½	1,133	+ 45	7·87	1
†Exeter	„ 14	298	— 7	2	560	— 69	5·5	..
Glasgow	„ 16	87,024	+2,248	..	816,964	+43,927	97·75	2·12
Hastings	„ 13	1,444	— 235	..	..	..	..	..
Huddersfield ..	..	..	..	..	..	..	..	..
Hull	„ 15	5,668	+ 460	2	6,274	+ 209	14·5	..
Ilkeston	„ 13	299	+ 27	..	..	..	10·5	..
†Ipswich	„ 8	295	— 16	..	..	..	4·25	..
Kilmarnock	„ 16	596	+ 17	48	7,218	+ 277	4·25	..
Lancashire United	„ 15	2,418	+ 152	..	17,643	— 492	39	..
†Leeds	„ 8	6,889	+ 492	..	..	..	57	..
Leicester	..	..	..	..	..	..	..	..
Leith	„ 15	1,145	+ 44	47⅔	28,217	+ 28	8·72	..
Liverpool	„ 8	21,892	+ 225	14	151,662	+ 3,846	116	6·5
‡L.C.C.	„ 5	82,414	+1,124	..	2,204,812	+208,760	138	6
London United ..	„ 15	11,798	+ 473	..	80,615	— 3,128	..	..
†Lowestoft	„ 8	1 5	— 12	27	4,190	+ 156	..	..
Manchester	„ 15	80,454	+2,017	2	34,757	+ 4,312	133	..
†Newcastle	„ 8	3,887	+ 315	..	4,897	+ 10	14·5	..
Newport	..	..	..	..	..	..	14·5	..
†Oldham	„ 9	1,787	+ 186	2	4,202	— 466	23·5	·5
Pontypridd	..	..	..	..	..	..	..	..
†Portsmouth	„ 8	1,584	+ 240	..	..	..	15·25	..
Preston	„ 12	1,847	+ 86	2	1,847	+ 30	..	..
Rotherham	..	..	..	..	..	..	..	..
Salford	„ 10	8,877	+ 137	..	..	..	..	..
†Sheffield	„ 9	6,115	+ 556	2⅓	12,910	— 485	40	..
Southampton ..	„ 12	1,714	+ 93	2	1,714	+ 86	..	..
Southend-on-Sea ..	„ 12	787	— 54	2	667	— 113	..	..
†South Shields ..	„ 8	540	+ 57	..	..	..	..	..
Swindon	„ 12	269	+ 21	2	228	— 2	..	..
†Tyneside	„ 5	403	+ 57	14	5,365	— 82	..	..
Wallasey	„ 15	1,984	+ 892	2½	2,176	+ 241	..	..
Walthamstow ..	„ 15	1,398	+ 161	..	..	..	9	..
West Ham	„ 6	4,745	— 559	..	..	..	15·25	..
Wolverhampton ..	„ 12	1,794	+ 56	2	1,500	+ 99	14·25	..
Cen. London Rly.	„ 15	9,922	—1,271	15	79,972	— 2,586	6·82	..
City & S. Lon. Rly.	„ 16	6,644	+ 318	15	51,497	+ 1,991	7·26	..
Dublin-Lucan Rly.	„ 14	245	— 1	15	1,611	— 98	7	..
G.N. and City Rly.	„ 15	2,905	+ 48	15	23,671	+ 1,004	3·5	..
L'pool Overh'd Rly.	„ 16	2,841	+ 202	15	20,744	+ 1,315	6·8	4·3
Llandudno-Col. Bay	„ 7	278	— 267	15	2,278	— 269	..	..
London Elec. Ry. Co.	„ 15	26,905	+ 760	..	211,600	+11,355	21·25	..
Mersey Railway ..	„ 15	4,251	+ 174	15	30,659	+ 685	4·5	..
Metropolitan Rly.	„ 16	38,610	+ 688	..	252,831	+ 6,846	24·5	..
Met. District Rly.	„ 15	22,645	+ 857	15	176,854	+13,612	24	..
Anglo-Argentine ..	„ 15	99,968	+8,929	..	744,087	+99,511	..	..
§Auckland	Mar.	16,054	+1,069	..	142,628	+14,480	29·3	·7
Bombay (B.B.T.) ..	8	5,721	+ 457	5	14,064	+ 657	..	..
Brisbane	Mar.	20,056	+2,066	12	56,891	+ 6,061	..	..
Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	April 15	7,880	+ 424	..	..	..	..	..
Cape Electric T.Ld.	..	..	..	..	..	..	20·5	..
§Kalgoorlie, W.A.	Mar.	3,639	..	..	9,851	..	..	..
§Lisbon	..	..	..	..	..	..	..	..
Madras	Mar. 15	1,725	+ 406	..	7,550	+ 874	..	..
§Montevideo ..	Mar.	28,493	+3,102	20	140,920	+13,478	..	..
†Perth (W.A.) ..	April 15	3,256	+ 53	..	22,960	+ 863	20	..

* Compared with the corresponding period of 1910. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

Upon the return of the Stock Exchange to business after the Easter recess, there was the usual accumulation of orders awaiting execution, and the balance certainly seemed to preponderate in favour of the buyers. Prices accordingly remained very hard, and in many departments there has been a further advance in prices.

The Home Railway market still remains the main centre of interest in the Stock Exchange. Many people are beginning to buy Home Rails, even at this comparatively late hour, and it would appear that even what is regarded generally as more or less rubbish has its supporters. One of the factors has been a brisk rise in District, which, after lying fallow round about 32 for a week or ten days, suddenly shot up on the eve of the holidays to 35, at which level, however, sellers appeared. A slight reaction took the price back to 34, after which a fresh set of buyers caused the stock to harden again. It is the turn of Metropolitan Consolidated to lag behind. The price, of course, has risen to a level which many people consider too high, having regard to the recent dividend record of the company; but the optimists look for much better things in the current year, and talk the price cheerily enough to 60. City and South London braced up a little after being a somewhat depressed market. The Central London issues went ahead strongly, on good buying of the Ordinary and Deferred stocks.

It is a curious commentary upon the complete change which has come over the Railway market, that whereas a little while ago Central London 4 per cent. Preferred stock was none too easy to sell, the position now is that buyers find they cannot get hold of any of the stock at all, even at the higher of the two quoted prices. In the ordinary way, some proprietors of the Ordinary would take the opportunity to convert their holding into Preferred and Deferred; but, apparently, they are content to wait for higher prices in their own stock, and the result, as already mentioned, is that the Preferred is not obtainable at all.

East London swing about a good deal. When last we wrote the price was 7¼, but since then it has firmed up to 7½, assisted by a big rise in the Ordinary stock of the Great Eastern Company, which is supposed to be flirting with the question of electrifying its own suburban lines and that of the East London as well.

Apart from the Home Railway market, considerable animation has re-developed in the stocks of the Anglo-American Telegraph Company, and prices rose substantially. The 6 per cent. Preferred, which was quoted *ex* 1½ per cent. dividend last Wednesday, regained this, and another point as well, on the day of the deduction, while the Deferred stock has shot up to nearly 28. The cause assigned in the market for these rises is that the negotiations for a working agreement with the American company are at length on the point of consummation, and although it has been supposed for the last six months that the difficulties in the way of this ratification would be solved, the element of uncertainty attaching to it had the effect of keeping prices down. It may be hoped that repeated recommendations of the Preferred stock as a good speculative investment have not been missed by those who have had the opportunity of picking up the stock during the recent depression, for it would appear that 120 is a very reasonable price for this security, provided the working agreement comes into force.

The renewal of the trouble in Mexico has had the natural effect of putting down prices of the traction, lighting and power issues, but the market has been puzzled to know how far the latest outbreak deserves serious attention. Consequently, prices became somewhat nominal for a time. The depression was limited to Mexican bonds and shares, other properties in this group not being influenced. Canadian General and Shawinigan Water have even improved.

Electricity supply shares are well-nigh motionless, and the industrial group is very steady. One of the British supply companies is about to make a comparatively small issue of Debenture stock, and the result of the experiment will be awaited with a good deal of interest. The rubber market has dropped into a groove of stagnation, and the course of the raw material perplexes the soundest authorities in Mincing Lane and Antwerp.

Parliamentary.—Third Readings.—In the House of Commons on April 18th, the Central London Railway Bill, Nottinghamshire and Derbyshire Tramways Bill, were read a third time.

Bill Withdrawn.—According to the *Times*, in the House of Commons on April 12th, the order for the second reading of the Rotherham, Maltby and District Railless Traction Bill was read and discharged, and the Bill was withdrawn.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1907.	1908.	1909.	1910.	Closing Quotations April 8th.	Closing Quotations April 18th.	Business done week ended April 18th, 1911. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
300,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	6½ — 6¾	6⅝ — 7⅛	6¾	..	+ ⅛	Nil.
$263,244,000	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	97 — 99	97 — 99	97⅛	..	..	5 1 0
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	8 %	150 —152	150 —152	..	..	..	5 5 3
$58,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
545,920	Anglo-American Telegraph	Stock	3½%	£3 4s.	3⅜%	3⅜%	69 — 71	71 — 73 xd	..	..	..	5 2 9
3,227,040	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	112¾—113¾	115½—116½ xd	116¾	113⅜	..	5 3 0
3,227,040	Do. do. do. Deferred	Stock	1 %	8/-	25/-	30/-	26⅜ — 26⅞	27½ — 28½	28	27 5/16	+ 1½	5 7 2
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	100 —102	100 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	7 1/16 — 7 5/16	7 1/16 — 7 5/16	..	..	..	5 9 5
2,462,309	Commercial Cable, Sting. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	87 — 89	88 — 90	88½	87⅞	+ 1	4 8 11
16,000	Cuba Telegraph	10	6 %	6 %	6 %	..	9¼ — 10¼	9¼ — 10⅜	..	..	..	5 9 1
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	17½ — 18½	17⅝ — 18½	..	..	..	5 9 7
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4%	3½ — 4	3¾ — 4	..	..	..	5 0 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10%	8½ — 8¾	8¾ — 8⅞	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 8
60,710	Direct United States Cable	10	4½%	4½%	4½%	5 %	7⅝ — 8⅛	7⅞ — 8 xd	..	..	..	6 5 0
32,500	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 8
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	135 —138	135 —139	138½	136	+1	5 0 9
2,000,000	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	84 — 86	84 — 86	85½	85¼	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	101¼—103¼	102 —104	103	101	+ ½	3 16 11
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	13½ — 13⅝	13⅜ — 13⅝	13⅝	13⅜	+ ⅛	5 0 11
752,400	Do. 4 % Deb. Stock..	Stock	4 %	4 %	4 %	4 %	99½—101½	100 —102	101½	101¼	+ ⅛	3 18 5
200,000‡	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	101 —103	102½	..	..	3 17 8
181,127	Globe Telegraph and Trust	10	5⅞%	5⅞%	5⅞%	..	10½ — 11	10⅝ — 11⅛	10⅞	10 11/16	+ ⅛	5 3 4
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13 — 13½	13 — 13½	13½	..	..	4 8 11
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	18 %	18 %	18%	32½ — 33½	32¾ — 33½	..	..	..	5 8 3
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13%	58 — 60	58 — 60	59½	..	..	5 8 4
$41,380,400	Mackay Companies Common	$100	4 %	4 %	4½%	5 %	93 — 96	93 — 96	..	..	..	5 4 2
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	78 — 80	78 — 80	..	..	..	5 0 0
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	2/-	1/-	+ ⅛	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	5 17 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	5 11 1
2,235,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	104 —105	104 —105	104⅛	104	..	5 14 3
3,735,000	Do. do. Def. Stock	100	6 %	6 %	6 %	6 %	186½—188½	187 —189	187½	186½	+ ½	4 6 4
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10 — 10⅜	10 — 10⅜	..	..	..	5 11 8
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10⅜ — 11	10⅛ — 11	..	..	..	5 9 1
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅞	5⅜ — 6⅛	6 1/16	5⅜	+ ⅛	4 1 8
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99 —101	99 —101	..	..	..	3 9 3
1,983,593	Do. do. 4 % Deb. Stock Red... ..	100	4 %	4 %	4 %	4 %	99 —101	99 —101	99⅜	..	..	3 19 4
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	8 %	8 %	8 %	..	1⅜ — 1⅜	1⅜ — 1⅜	..	..	..	4 11 6
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1 3/16 — 1 1/8	1 3/16 — 1 1/8	..	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	87½ — 89½	87½ — 89½	88⅜	88	..	4 0 5
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —101	99½—101½	..	..	+ ⅛	3 18 10
11,839	Reuter's	8	5 %	5 %	5 %	..	7⅜ — 8⅜	7⅜ — 8⅜	..	..	..	4 10 11
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	98½—100⅛	99 —101	..	..	+ ⅛	4 9 1
2,992	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	..	134 —137	131 —134 xd	..	..	..	4 9 7
150,000	United River Plate Telephone	5	8 %	8 %	8 %	..	7¼ — 7⅜	7¼ — 7⅜	7⅜	..	..	5 8 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅛ — 5⅝	..	..	..	4 7 11
30,008	W. Coast of America, 1 to 90,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1½ — 1⅝	1½ — 1⅝	..	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —101	99½—101½	..	..	+ ⅛	3 18 10
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	6 %	13½ — 14	13⅜ — 14	13½	13 1/16	— ⅛	4 5 9
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 19 3
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	2⅜ — 3	2 13/16 — 3 1/16	59/4½	57/3	+ 1/16	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10⅜ — 10⅝	10½ — 10⅝	..	..	+ ⅛	5 11 7
4,669	Do. do. 6 % Cum. 2nd Pref.	10	£2 6	15 %	14½%	..	9 — 9½	9¼ — 9⅝	..	..	+ ⅛	6 6 8
80,000‡	Do. do. 5 % Debs., Nos. 1 to 800 ..	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	5 %	5 %	5 — 5½	5 — 5½	5 5/16	5 5/16	..	4 15 3
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	5 %	5 %	4½ — 5	4½ — 5	98/11½	97/6	..	5 0 3
4,465,674	Do. 4 % Deb. Stock	Stock	..	4 %	4 %	4 %	92 — 93½	92 — 93½	93	92½	..	4 5 7
329,002	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	104½—106½	104½—106½	..	..	..	4 13 11
830,000	Babcock & Wilcox, 1 to 830,000	1	20 %	20 %	24 %	26 %	5⅜ — 5½	5 3/16 — 5 5/16	5 5/16	5⅛	+ 1/16	4 8 10
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜ — 1½	1⅜ — 1½	..	..	..	4 0 0
600,000	British Columbia E. Rail Def. Ord. Stock ..	100	8 %	8 %	8 %	8 %	151 —155	150 —154	..	..	—1	5 3 11
600,000	Do. Pref. Ord. Stock	100	5 %	6 %	6 %	..	125 —128	124 —127	126¼	126	—1	4 16 9
600,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	..	108 —111	107½—110½	110	109½	— ½	4 10 6
230,800	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —105	100 —103 xd	..	..	..	4 6 7
210,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
133,301	British Electric Traction	10	Nil	Nil	Nil	..	1⅞ — 2⅛	1⅛ — 2 1/16	..	..	— 1/16	Nil
161,437	Do. do. 6 % Cum. Pref.	10	3 %	1¾%	Nil	..	4⅛ — 5⅛	4⅛ — 5⅛	98/11½	..	..	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	94 — 98	94 — 98	96	95	..	5 2 0
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	80 — 85	79 — 84	81	..	—1	5 7 2
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	6⅞ — 7⅛	6⅞ — 7⅛	7 1/16	..	+ ⅛	6 15 7
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6⅛	5⅞ — 6⅛	6 1/16	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..	4 7 5
201,579‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
500,000	British Westinghouse 10 % Pref., 1 to 200,000 and 275,001 to 575,000 Non-cum.	5	Nil	Nil	Nil	..	5/16 — 7/16	5/16 — 7/16	..	..	..	Nil
1,241,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	59 — 62	59 — 62	..	..	..	6 9 1
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,388	Brush Electrical Engineering, Ord., 1 to 140,388 ..	2	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
199,335	Do. do. Non-cum. 7 % Pref... ..	2	Nil	Nil	Nil	..	3/16 — 1/4	3/16 — 1/4	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	56 — 61	58 — 63	..	..	+2	7 2 10
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	38 — 43	40 — 45	..	..	+2	10 0 0
137,610	Calcutta Trams, 1 to 137,610	5	6 %	4½%	4½%	6 %	5⅜ — 5⅝	5⅜ — 6	5⅝	..	+ ⅛	5 0 0
47,295	Do. 5 % Cum. Pref., 1 to 47,295 ..	5	5 %	5 %	5 %	5 %	4⅜ — 5⅛	5 — 5⅛	..	..	+ ⅛	4 15 3
850,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	98 — 101	..	..	+1	4 9 1
35,000	Callender's Cable Construction shares	5	15 %	15 %	10 %	..	9⅜ — 9⅞	9⅜ — 9⅞	9⅜	..	..	5 1 3
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 17 1
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	..	1/16 — 3/16	1/16 — 3/16	9/9	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	12 %	12½%	17½%	..	3 1/16 — 3 5/16	3 1/16 — 3 5/16	70/-	65/3	+ ½	5 14 9
205,369	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4 %	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
1,854,720	Central London Railway, Ord. Stock	Stock	3 %	3½%	3 %	3 %	72 — 74	74 — 76	75½	73	+2	3 18 11
672,640	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	87 — 89	88 — 90	90	88½	+1	4 8 11
672,640	Do. do. Def. do.	Stock	2 %	2½%	2 %	2 %	57 — 59	62 — 64	63	61	+5	3 2 6
1,480,000	City and South London Railway	Stock	2½%	1½%	1⅞%	1½%	33 — 34	35 — 36	35	33½	+2	4 3 4
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 1,100 of £50 Red.	..	5 %	5 %	5 %	5 %	70 — 80	70 — 80	..	..	..	6 0 5

* Unless otherwise stated, all shares are fully paid.

‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations April 8th.	Closing Quotations April 18th.	Business done week ended April 18th, 1911.		Rise + or Fall —	Present Yield per cent.
		*	1907.	1908.	1909.	1910.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	6 %	5 %	..	7/8 — 1	7/8 — 1	..	..	..	5 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — 1 1/8	1 — 1 1/8	..	..	..	5 6 8
265,480	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12½— 13½	12½— 13½	..	..	..	4 10 7
99,261	Edison & Swan Utd., "A" shs., £8 pd., 1 to 99,261	5	2½%	Nil	Nil	..	5/16— 7/16	5/16— 7/16	11/6	10/6	..	Nil
17,139	Do. "A" shares, 01—017,139	5	2½%	Nil	Nil	..	1½ — 2⅝	1½ — 2	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	69 — 73	69 — 73	..	..	..	5 12 8
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	78 — 81	78 — 81	..	..	..	6 3 5
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	⅜ — 1	⅜ — 1	17/9	17/-	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	1½ — 2	1½ — 2	38/-	37/6	..	7 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	83 — 88	83 — 88	..	..	..	4 10 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	⅛%	Nil	Nil	..	1⅛ — 1½	1⅛ — 1½	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10½ — 10⅝	10½ — 10⅝	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103½	102 —103¼	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	12 — 12⅝	12 — 12⅝	12 1/16	..	..	5 9 1
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	4 15/16— 5 1/16	4 15/16— 5 1/16	5 1/16	..	..	4 6 8
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½%	4½%	4½%	4½%	107½—109½	108 —110	..	..	+ ½	4 1 10
60,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	..	16½ — 17	16½ — 17	..	..	..	5 17 8
37,500	†Liverpool Overhead Railway, Ord.	10	⅛%	Nil	Nil	1⅛%	2⅜ — 2 1/16	2⅜ — 2 1/16	..	..	..	5 9 1
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	8⅜ — 8½	8⅜ — 8½	..	..	..	5 17 8
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	Nil	Nil	Nil	1⅜ — 2⅜	1⅜ — 2⅜	..	..	..	Nil
399,930	Do. do. 60,008 to 100,000	10	3 %	Nil	Nil	Nil	1⅜ — 2⅜	1⅜ — 2⅜	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	3⅜%	Nil	Nil	2⅜ — 3⅛	2⅜ — 3⅛	59/9	..	..	..
1,649,980	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	74 — 77	74 — 77	76⅔	74½	..	5 3 11
5,732,062	Metropolitan Consolidated	100	¼%	¼%	1 %	1⅛%	54½ — 55	54⅝ — 55	55⅝	54⅜	..	2 0 11
2,640,914	Do. Surplus Lands	100	2⅜%	2⅜%	2⅜%	2⅜%	66 — 68	66 — 68	67⅜	..	..	4 0 11
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	32 — 32½	34 — 34½	34⅜	32	+2	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	4½%	5%	5½%	⅞ — 1	1⅛ — 1⅛xd	..	..	..	5 10 0
314,016	Do. do. Defd.	1	Nil	Nil	Nil	Nil	3/16— 5/16	3/16— 5/16	2/8	..	— 1/16	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	7/8— 15/16	7/8— 15/16	17/6	..	..	5 9 7
589,183	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	102½—104½	102 —104	103⅜	103½	— ½	4 6 7
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	6 %	127 —128	124 —126 xd	125	124	..	4 15 3
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	5 %	5 %	..	96 — 97	96 — 97	96⅞	95½	..	5 3 1
245,000	Potteries Electric Traction	1	4 %	Nil	2 %	..	3/16— 5/16	3/16— 5/16	..	..	..	4 16 11
245,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	3/16— 5/16	3/16— 5/16	14/-	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	87 — 90	87 — 90	90	..	..	4 19 5
87,350	Telegraph Construction and Maintenance	12	17½%	15 %	17½%	20 %	36 — 38	36 — 38	37½	36½	..	6 7 0
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1919	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 5 0
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	5 %	5 %	..	102 —103	102 —103	102⅜	..	..	4 17 1
2,818,700	Do. do. 4½ % Bonds	..	..	4½%	4½%	..	98 —100	98 —100	99	98½	..	4 10 0
4,928,050	Do. do. 6 % Income Bonds	..	..	..	..	1 %	56 — 58	55 — 57	57	55½	—1	1 15 1
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	10 %	5 %	Nil	Nil	3/16— 5/16	1/8 — 3/16	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	6 %	3 %	Nil	½ — 1	½ — 1	..	..	— ½	..
215,769	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 3 1

ELECTRICITY SUPPLY COMPANIES.

80,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 80,449	5	10 %	10 %	10 %	10 %	7⅞— 7⅞	7⅞— 7⅞	7 7/8	..	..	6 12 3
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅞— 7⅞	7⅞— 7⅞	..	..	..	4 11 10
402,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —103	99 —103	..	..	..	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	4 — 4½	4 — 4½	..	..	..	5 11 10
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜ — 4⅝	4⅜ — 4⅝	90/-	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅝ — 4⅛	3⅝ — 4⅛	..	..	..	5 2 10
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..	4 1 8
49,486	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	5 %	4 — 4½	4 — 4½	85/-	82/6	..	5 11 1
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	7 %	7 %	11½ — 12	11½ — 12	11⅝	..	..	5 16 8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	12⅝	..	..	4 12 4
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	119 —123	119 —123	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
50,000	County of Durham Electrical Power, Ord.	5	2 %	Nil	Nil	..	1⅛— 2	1⅛— 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	..	2⅜— 3⅛	2⅜ 3 xd	..	..	..	8 6 8
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	5 %	5 %	5 %	92 — 94	92 — 94	..	..	..	5 6 5
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅞— 8⅛	7⅞— 8⅛	..	..	..	6 3 1
55,000	Do. do. 6 % Pref., 40,001—80,000 and 120,001—135,000	10	6 %	6 %	6 %	6 %	10¾— 11¼	10¾— 11¼	..	..	..	5 6 8
450,000	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	108½—111½	108½—111½	..	..	..	4 0 9
450,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	..	1/16— 3/16	1/16— 3/16	12/9	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	Nil	Nil	Nil	..	2⅛ — 3⅛	3 — 3⅛	..	..	+ ⅛	Nil
480,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	84 — 87	84 — 87	..	..	..	5 3 6
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	5 %	5 %	..	81½ — 83½	81½ — 83½	82	..	..	5 17 0
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	6 %	4½ — 4⅝	4⅝ — 4⅝ xd	..	..	..	6 9 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4⅝ — 5⅛	4⅝ — 5⅛ xd	..	..	..	4 15 8
94,350	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
15,000	Hove, 1 to 15,000	5	8½%	8½%	8½%	9 %	6⅝ — 7⅛	6⅝ — 7⅛ xd	..	..	..	5 19 4
$1,526,500	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	5 %	5 %	..	102 —104	102 —104	103¾	..	..	4 16 2
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	8 %	8 %	9 %	7 — 7⅛	7 — 7⅛	..	..	..	5 16 2
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
111,000	London Electric Supply Corporation, Limited, Ord.	3	2½%	3 %	2 %	2 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	3 3 6
90,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	5	..	..	5 17 1
387,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½%	4 %	4 %	4 %	91 — 94	91 — 94	..	..	..	4 5 1
200,000	Metropolitan Electric Supply, 100,001 to 300,000	5	6½%	5 %	5 %	5 %	3⅛ — 4 1/16	3⅞ — 4⅛	..	..	— 1/16	5 2 7
76,121	Do. 4½ % Cum. Pref. 1—76,121	5	4½%	4½%	4½%	4½%	4⅜ — 4⅝	4⅜ — 4⅝	80/-	77/6	..	4 17 4
250,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	86 — 89	86 — 89	..	..	..	3 18 8
$5,929,600	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	90 — 91	89½ — 89½	90	89½	— ½	5 1 6
$13,585,000	Do. Light and Power Co., Ltd., Common	$100	4 %	3½%	4 %	..	88 — 90	86 — 88 xd	88½	88½	..	4 10 11
$5,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	7 %	7 %	..	110 —112	106½—108½ xd	111½	107½	..	6 9 0
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	5 %	5 %	5 %	95 — 96	94½— 95½	95½	94½	— ½	5 4 9
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..	4 14 3
180,491	Newcastle-on-Tyne, 1 to 50,000 & 57,010 to 187,500	5	8 %	2½%	4 %	4 %	4 — 4⅛	3⅞ — 4⅛ xd	..	..	..	4 14 1
187,500	Do. 5% Pref., 1 to 187,500 Non-Cum.	5	5 %	5 %	5 %	5 %	4⅜ — 4¼	4¼ — 4⅜ xd	..	..	..	5 5 3
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	5 %	..	97½ — 99½	96 — 97 xd	..	..	..	5 3 1
10,852	Notting Hill Electric Lighting	10	7½%	7 %	7½%	8 %	12 — 12⅝	12 — 12⅝	..	..	..	6 5 6
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	..	6 — 6⅛	6 — 6⅛	..	..	..	5 7 8
120,000	River Plate Elcty. Co. Ord.	Stock	6 %	8 %	9 %	..	225—235	225 —235	..	..	..	3 16 6
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	..	103—113	103 —113	..	..	..	5 6 2
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	102—104	102 —104	..	..	..	4 16 3
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10%	8⅛ — 9	8⅛ — 9	..	..	..	5 11 1
80,000	Do. do. 7 % Pref. 30,081 to 40,080	5	7 %	7 %	7 %	7 %	6¾ — 7⅛	6¾ — 7⅛	..	..	..	4 16 7
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	86 — 88	86 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	Nil	1⅜ — 1⅞	1⅜ — 1⅞	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	4 %	5 %	5 %	5 %	2 3/16— 2 5/16	2 3/16— 2 5/16	..	..	..	6 7 0
100,000	Do. do. 5 % 1st Mort. Deb.	100	..	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 3
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	Nil	Nil	3/16— 5/16	3/16— 5/16	..	..	..	Nil
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 1/16— 1 3/16	1 1/16— 1 3/16	..	..	..	5 17 11
240,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	2⅛ — 2⅜	2 — 2⅛	..	..	+ ⅛	22 2 4
60,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	1⅞ — 2⅛	2 — 2⅛	..	..	+ ⅛	10 0 0
271,700	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	85 — 87	85 — 87	..	..	..	5 3 6
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	5 %	..	..	1⅜ — 1 5/16	1 — 1 1/16	21/-	20/6	+ ⅛	4 17 7
110,000	Westminster Electric Supply, Ord.	5	10 %	10 %	10 %	10%	7⅞— 8⅛	7⅞— 8⅛	8 1/16	..	..	5 19 5
81,270	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	5	..	..	4 3 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 3 per cent. March 9th, 1911

TRADE STATISTICS OF CANADA.

The following figures showing the imports into, and exports from, Canada of electrical and similar materials during the year ended March 31st, 1910, are taken from the recently issued trade statistics; figures for the year 1908-9 are given for purposes of comparison, and notes of any increases or decreases have been added:—

	1908-9. Dollars.	1909-10. Dollars.	Increase or decrease. Dollars.
Brass wire, plain.—			
From Great Britain ...	44,000	6,000	— 38,000
,, Germany	3,000	—	— 3,000
,, United States ...	5,000	36,000	+ 31,000
,, Other countries ...	1,000	—	— 1,000
Total ...	53,000	42,000	— 11,000
Railway passenger cars.—			
From United States ...	227,000	121,000	— 106,000
Tram or horse cars.—			
From United States ...	21,000	22,000	+ 1,000
Celluloid manufactures.—			
From Great Britain ...	8,000	12,000	+ 4,000
,, Germany	3,000	5,000	+ 2,000
,, United States ...	35,000	73,000	+ 38,000
,, Other countries ...	3,000	10,000	+ 7,000
Total ...	49,000	100,000	+ 51,000
Coal, bituminous.—			
From Great Britain ...	140,000	91,000	— 49,000
,, United States ...	13,011,000	12,979,000	— 32,000
Total ...	13,151,000	13,070,000	— 81,000
Copper wire, plain, tinned or painted.—			
From Great Britain ...	1,000	24,000	+ 23,000
,, United States ...	36,000	61,000	+ 25,000
Total ...	37,000	85,000	+ 48,000
Electric light carbons and carbon points.—			
From Great Britain ...	3,000	1,000	— 2,000
,, Austria	3,000	—	— 3,000
,, Germany	15,000	14,000	— 1,000
,, United States ...	24,000	28,000	+ 4,000
,, Other countries ...	1,000	2,000	+ 1,000
Total ...	46,000	45,000	— 1,000
Electric apparatus not mentioned—insulators, electric and galvanic batteries, telegraph and telephone instruments.—			
From Great Britain ...	66,000	398,000	+ 332,000
,, Austria	2,000	5,000	+ 3,000
,, France	5,000	3,000	— 2,000
,, Germany	5,000	5,000	—
,, Sweden	1,000	17,000	+ 16,000
,, United States ...	1,550,000	2,487,000	+ 937,000
,, Other countries ...	1,000	1,000	—
Total ...	1,630,000	2,916,000	+1,286,000
Incandescent lamp bulbs, &c.—			
From Great Britain ...	1,000	—	— 1,000
,, Austria	7,000	19,000	+ 12,000
,, United States ...	42,000	53,000	+ 11,000
,, Other countries ...	1,000	1,000	—
Total ...	51,000	73,000	+ 22,000
Electric motors, generators, dynamos and sockets.—			
From Great Britain ...	18,000	35,000	+ 17,000
,, France	4,000	2,000	— 2,000
,, Norway	4,000	—	— 4,000
,, Sweden	1,000	28,000	+ 27,000
,, United States ...	294,000	428,000	+ 134,000
Total ...	321,000	493,000	+ 172,000
Lamp chimneys, glass shades and globes.—			
From Great Britain ...	4,000	7,000	+ 3,000
,, Austria	17,000	14,000	— 3,000
,, Germany	16,000	13,000	— 3,000
,, United States ...	104,000	161,000	+ 57,000
,, Other countries ...	1,000	1,000	—
Total ...	142,000	196,000	+ 54,000
Rubber belting.—			
From Great Britain ...	2,000	13,000	+ 11,000
,, United States ...	31,000	51,000	+ 20,000
Total ...	33,000	64,000	+ 31,000

	1908-9. Dollars.	1909-10. Dollars.	Increase or decrease. Dollars.
Manufactures of india-rubber and gutta-percha.—			
From Great Britain ...	80,000	112,000	+ 32,000
,, Austria	7,000	6,000	— 1,000
,, France	4,000	3,000	— 1,000
,, Germany	21,000	39,000	+ 17,000
,, United States ...	333,000	479,000	+ 146,000
,, Other countries ...	1,000	2,000	+ 1,000
Total ...	446,000	641,000	+ 195,000
Locomotives for railways.—			
From Great Britain ...	6,000	33,000	+ 27,000
,, United States ...	378,000	314,000	— 64,000
Total ...	384,000	347,000	— 37,000
Gasoline engines.—			
From Great Britain ...	17,000	35,000	+ 18,000
,, United States ...	698,000	955,000	+ 257,000
,, Other countries ...	—	10,000	+ 10,000
Total ...	715,000	1,000,000	+ 285,000
Steam engines.—			
From Great Britain ...	38,000	30,000	— 8,000
,, United States ...	196,000	217,000	+ 11,000
,, Other countries ...	—	6,000	+ 6,000
Total ...	234,000	253,000	+ 19,000
Boilers.—			
From Great Britain ...	31,000	116,000	+ 85,000
,, United States ...	123,000	124,000	+ 1,000
,, Other countries ...	—	3,000	+ 3,000
Total ...	154,000	243,000	+ 89,000
All machinery not mentioned except sewing machines, textile machinery, printing machinery, &c.—			
From Great Britain ...	503,000	592,000	+ 89,000
,, France	41,000	13,000	— 28,000
,, Germany	37,000	56,000	+ 19,000
,, United States ...	4,925,000	6,446,000	+1,521,000
,, Other countries ...	11,000	30,000	+ 19,000
Total ...	5,517,000	7,137,000	+1,620,000
Iron and steel wire, single or several, covered with cotton, linen, silk, rubber or other material, including cable so covered.—			
From Great Britain ...	162,000	161,000	— 1,000
,, United States ...	110,000	159,000	+ 49,000
,, Other countries ...	6,000	9,000	+ 3,000
Total ...	278,000	329,000	+ 51,000
Iron and steel wire, not mentioned (except fencing wire).—			
From Great Britain ...	16,000	46,000	+ 30,000
,, Germany	23,000	23,000	—
,, United States ...	93,000	141,000	+ 48,000
,, Other countries ...	5,000	1,000	— 4,000
Total ...	137,000	211,000	+ 74,000
Belting, leather.—			
From Great Britain ...	136,000	166,000	+ 30,000
,, United States ...	3,000	7,000	+ 4,000
Total ...	139,000	173,000	+ 34,000
Lighting fixtures of metal, including electric light fixtures of metal.—			
From Great Britain ...	21,000	19,000	— 2,000
,, Austria	26,000	2,000	— 24,000
,, United States ...	295,000	354,000	+ 59,000
,, Other countries ...	11,000	10,000	— 1,000
Total ...	353,000	385,000	+ 32,000
Asbestos Manufactures.—			
From Great Britain ...	18,000	19,000	+ 1,000
,, United States ...	160,000	174,000	+ 14,000
,, Other countries ...	3,000	6,000	+ 3,000
Total ...	181,000	199,000	+ 18,000
Plumbago, ground and manufactured.—			
From Great Britain ...	2,000	4,000	+ 2,000
,, United States ...	26,000	36,000	+ 10,000
Total ...	28,000	40,000	+ 12,000
EXPORTS.			
Mica.—			
To Great Britain ...	69,000	11,000	— 58,000
,, United States ...	137,000	287,000	+ 150,000
,, Other countries ...	3,000	1,000	— 2,000
Total ...	209,000	299,000	+ 90,000

	1908-9. Dollars.	1909-10. Dollars.	Increase or decrease. Dollars.
Electrical Apparatus.—			
To Great Britain ...	4,000	2,000	— 2,000
„ Newfoundland ...	11,000	3,000	— 8,000
„ France	3,000	—	— 3,000
„ United States ...	63,000	21,000	— 42,000
„ Other countries ...	2,000	2,000	—
Total ...	83,000	28,000	— 55,000
India-rubber manufactures.—			
To Great Britain ...	8,000	9,000	+ 1,000
„ Newfoundland ...	3,000	3,000	—
„ New Zealand ...	5,000	8,000	+ 3,000
„ United States ...	86,000	34,000	— 52,000
„ Japan	—	2,000	+ 2,000
„ Other countries ...	2,000	—	— 2,000
Total ...	104,000	56,000	— 48,000
Machinery.			
To Great Britain ...	40,000	30,000	— 10,000
„ Newfoundland ...	29,000	22,000	— 7,000
„ New Zealand ...	21,000	10,000	— 11,000
„ Argentina	15,000	8,000	— 7,000
„ France	10,000	43,000	+ 33,000
„ United States ...	441,000	238,000	— 103,000
„ Other countries ...	33,000	90,000	+ 57,000
Total ...	589,000	441,000	— 148,000

N.B —Dollar = 4s. 1½d.

ARC-LAMP ELECTRODES.*

By A. MAHLKE.

(*Concluded from page* 591.)

Before the mixture can be shaped into final form it must be kneaded, and this operation is performed either by rolling mills or by pan rolls. Fig. 4 shows one of the latter. Two rolls about 5 ft. in diameter and weighing about 2,000 lb. each turn in a pan containing the mixture to be kneaded. Two pairs of boards or scrapers keep the mixture in the path of the turning rolls. Most of the pan rolls used in this country are constructed so that the pan turns while the rolls and the boards remain stationary. This construction is not so effective because the pan yields somewhat, so that there is not the same pressure brought on the material to be kneaded as there is in the construction described above. After being well kneaded the mixture is placed in cylinders suited for a hydraulic press, in which it is shaped into carbon shells. A shovelful of the mixed material is put into a cylindrical mould and rammed down by a tamping press. Then another shovelful of the material is added and rammed down, and so on until the mould is filled and a homogeneous, solid cylinder of the mixed material obtained. The cylinders are then placed in a hydraulic press like that shown in fig. 5.

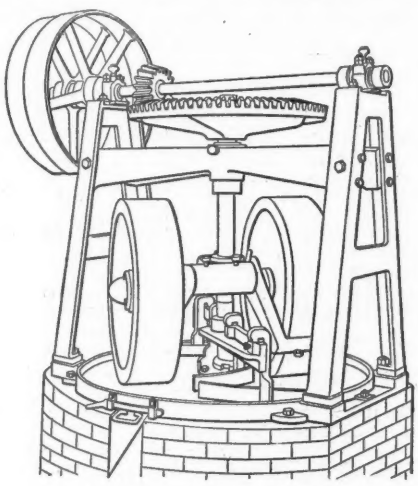


Fig. 4.—Pan-Roll Kneading Machine.

Manufacture of Electrodes.

The press consists of two parts A and B connected together by two steel shafts. The part A contains the nozzle *n* out of which the electrodes are forced, while the part B contains the hydraulic cylinder and the piston *k*. Fastened to the piston *k* is the piece *g* bearing on its lower end the toothed segment *s*. Connected to the piece *g* is a hollow pressure cylinder *c* supported by the piece *d* sliding on the lower shaft. The pressure cylinder adjoins the piece bearing the dented wheel *z* meshing in the toothed segment *s*, by means of which the hollow pressure cylinder can be turned out of its position around the lower shaft so that it is open at its left side for the reception of the carbon cylinders. The lever *h* performs this movement, and the counterbalance makes it easier to place the hollow pressure cylinder in its former position.

The operations of the press are regulated by the toothed rod *z'* having stops *y* and *y'* which move the part *g* to the right or left, while its teeth engage the little cog-wheel *b*, moving by a toothed segment the valve *v*. Above this valve a pressure gauge is placed. The cog-wheel *b* can also be turned by the hand-wheel *r'*. When by these means the valve *v* is opened the material contained in *c* is forced through the hollow pipe *i*, which is heated by a steam jacket, and out of the nozzle *n* as a continuous rod.

When hollow electrodes are desired, instead of the nipple *p* a mouthpiece like that shown in fig. 6 is fixed on the end of the pipe *i*. By means of the ring *r* and three rods *s* the rod *d* is kept in the centre of the orifice *m*, which is fitted with a transition cone *u* for decreasing slowly the cross-section of the carbon material moving from right to left around the rod *d* and emerging from the orifice *m* as a continuous hollow cylinder with a hole corresponding to the end of the rod *d*.

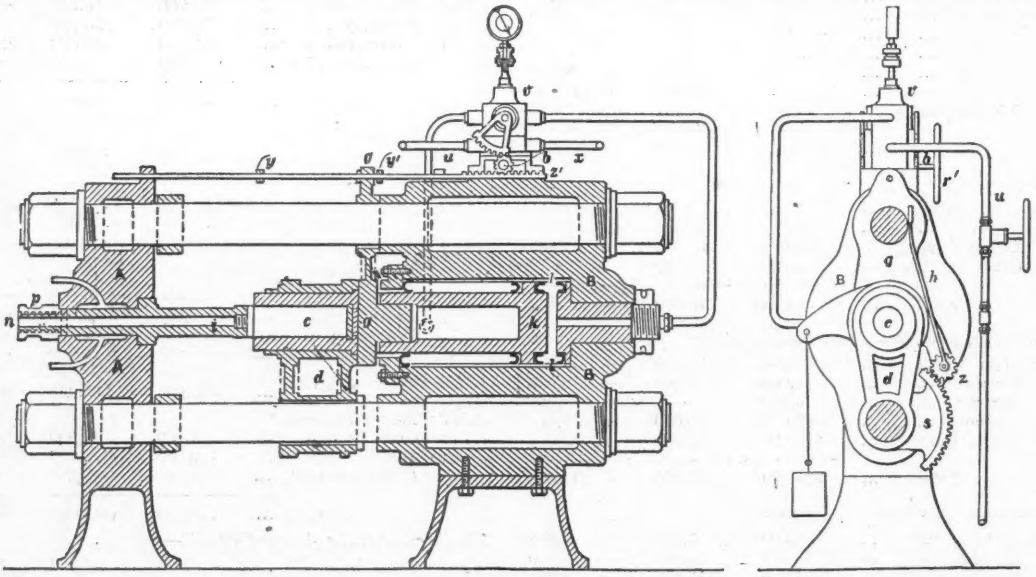


Fig. 5.—Hydraulic Press for Making Electrodes.

* From the *Electrical World*.

The diameters of the orifice m and the rod d must be a little larger than the corresponding dimensions of the electrodes to be made, so as to allow for shrinkage when baking in the furnace. The pressure necessary for making tar carbons is about 1,500 lb. to 1,800 lb., and the temperature about 80° C. For pitch carbons the pressure as well as the temperature is somewhat higher. When making the latter carbons it is usually necessary to heat the mouthpiece of the press by a gas flame, but this is not necessary in the case of tar carbons.

The carbon rod from the hydraulic press is cut by hand into pieces 4 ft. to 5 ft. in length, and these pieces are bound together into hexagonal bundles about 10 in. in diameter. The bundles then lie in storage for some days before they are put into the furnace. When ready, the bundles are put in a vertical position in saggers of the form shown in fig. 7, closed by a cover. These saggers are usually made in the carbon factory itself with much care, so that they may be used for a number of runs. The materials used for their manufacture are 30 parts kaolin and 20 parts of highly refractory clay mixed with 50 parts grog (scrap of broken saggers ground to a coarse flour). This is mixed with water, molded into shape and then allowed to dry by standing in the open air. When thoroughly dried the saggers are covered with a glazing material and baked in a furnace at a temperature of at least 1,300° C. A well-made sagger, if handled properly, can be used about 15 times for baking electrodes.

Into these saggers the hexagonal carbon bundles are put, while the space between the bundles and the wall of the sagger is filled with a coarse coke product, which is also placed on top of the bundle to replenish the whole sagger. The cover is then fixed on top of the sagger by means of a clay paste.

Furnaces for Baking Electrodes.

For economy and ease of baking all material at the same temperature, ring furnaces are best suited. These furnaces, like similar brick furnaces, consist of a series of chambers or compartments, 32 being usually connected to a ring by flues so that the heat can pass through all chambers one after the other in continuous movement. Suitable dimensions of chambers are:—Length, 9 ft.; width, 5 ft.; and depth, 6 ft. to 7 ft.

By building the whole furnace below the level of the floor and making the depth of the chambers larger than the width, since only the heat radiated from the covers is lost, the heat losses are reduced as much as possible. The fire progresses daily in the series of chambers by four such compartments, so that the whole furnace takes about eight days to heat, after which time the fire is working again on the same chamber as at the beginning. The chambers ahead of the fire are heated by the combustion gases, which leave the furnace at the eighth or tenth chamber beyond the fire before going to the stack, when their temperature is about 200° C. The air necessary for supporting the fire is conducted through the heated chambers which the fire has left, cooling these chambers and producing a very high temperature (1,400° C.) in the chambers under fire. Thus, nearly all the heat produced in the furnace is used for its proper purpose and a very small part of it lost.

The fire progressing by four chambers a day, it is necessary to open four cooled chambers to take the electrodes out and to fill the chambers up again. In a furnace of the dimensions given above about 3,000 kg. (3 tons) of electrodes can be baked in 24 hours. If producer gas were employed in this furnace it would require nearly 1,500 kg. (3,306 lb.) of fuel, producing 7,000 calories per kg. (12,600 lb.-F. units per lb.). In many places natural gas can be burned in the ring furnaces, making the operation of the furnace much easier, because natural gas has a greater heating power, and does not clog up the flues in the furnace with tar vapours, which in producer gas are contained in so large an amount that after some months' working the flues of the furnace are closed by the deposits of the gas, necessitating the shutting-down of the furnace and the cleaning of the flues. The draught in the furnace should be kept as low as possible in order to prevent the cracking of the hot saggers. The author has found a draught of 2 mm. water pressure in the chambers of the furnace sufficient.

The baked electrodes are now cut to proper length for arc lamps and assorted, the crooked and cracked electrodes being rejected and scrapped. After that one end of the carbon is pointed, while the other is finished off smooth. The electrodes thus prepared can be cored. This operation is performed by little presses consisting of a hollow cylinder into which the coring material is to be filled. The latter is forced out of a little hole with which the hollow cylinder is provided, and against which one end of the carbon to be cored is held.

The operation of coring can be done either by automatic machines utilising a weight on a piston or by hydraulic pressure, or it may be performed by hand, the piston in the hollow cylinder containing the coring material being moved by a screw and hand-wheel. Short electrodes having thick shells can be cored best by automatic machines, while longer electrodes with thin shells must be cored by hand, it being easier by this means to regulate or proportion the pressure to the strength of the shell.

Composition of Coring Material.

The coring material for common arc-lamp electrodes burnt in open arc lamps, projector lamps and other similar lamps is made of two parts of baked lampblack and one part of potassium silicate. The baked lampblack is of 200 mesh, and the potassium silicate is applied as a solution, made with steam and hot water, and has a density of 24° Beaumé for direct-current electrodes, and a little lower density usually for electrodes for alternating-current lamps. The potassium silicate acts as a binder for the material of the core, and the potassium, when burnt in the arc, reduces its counter E.M.F. An arc consuming carbon alone requires a much higher voltage, so that an arc of the lower voltage for which the lamp is regulated can exist only at the end of the core. Thus, the arc is maintained at that place so long as there are no impurities in the shells, which could reduce the voltage of the arc, like the potassium of the core.

The coring mixture for flaming arc lamp electrodes is more complicated, containing as it does metallic salts for feeding the arc. When Bremer first introduced this kind of lamp, the same sort of electrodes in which the core had a diameter of about one-third of the shell were used for the positive and negative, as well as for the alternating-current lamps. At the author's proposal, different kinds of electrodes have been made for these different purposes. In

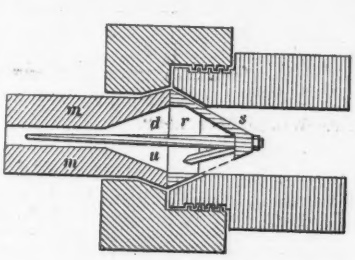


Fig. 6.—Mouthpiece for Hollow Electrodes.

Fig. 7.—Sagger.

direct-current lamps the positive electrodes have a core with a diameter about half that of the shell, while in the negative electrodes and those used for alternating-current lamps the diameter of the core is about one-third that of the shell. The reason for this construction is because in operation particles of the positive electrode are carried over and deposited on the negative electrode. The positive electrode, therefore, must contain as much metallic salts as possible, while the negative electrode usually contains no such salts, and is made in the same manner as common carbon electrodes, its core consisting of lampblack and potassium silicate only. But for very many lamps it is usually best to provide the negative electrodes with metallic salts also.

The composition for the core of positive electrodes for direct-current lamps, as well as the material for the electrodes of alternating-current lamps, consists of 40 per cent. of baked lampblack and 60 per cent. of metallic salts. The metallic salts for electrodes giving a yellow flame are calcium fluoride and calcium phosphate, which latter must be calcined. For alternating-current lamps less phosphate is used than for direct-current lamps, and the phosphate may even be omitted. A German firm adds to the calcium salts about 10 per cent. of cerium salts, which makes the yellow light more whiteish.

The cerium salts, which are a by-product of the Welsbach mantle industry, are the principal ingredients of the electrodes giving a white light. Usually cerium fluoride forms two-thirds of the core mixture contained in these electrodes, the other third being mostly calcium salts.

The powders out of which the core is to be made must be sifted very well and be mixed very carefully, else the core of the finished electrode will have white spots which cause disturbances of the light when burned in the flame. As a binding material potassium silicate, which is made alkaline by adding some potassium

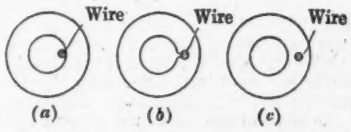


Fig. 8.—Wired Electrodes.

hydroxide, is used. In certain flaming-arc electrodes potassium silicate is not used as a binding material, but some organic substance, like glucose. In such a case there is added to the core a small amount of potassium salts or boric acid. These materials may be necessary for starting the arc because metallic salts, like calcium and cerium fluoride, have high melting and boiling points.

When the electrodes have been cored they must be dried at a temperature of about 150° C. This must be done very slowly so that the core fills up the inside of the shell, leaving no hole anywhere. If there is no connection between the core and the shell in any part, the current cannot pass from the shell to the core, which fault will cause a disturbance in the light when that part comes near to the burning end.

The flaming-arc electrodes destined for long-hour burning, having a length of more than 16 in., have to be provided with a wire to reduce their electrical resistance. Such long electrodes without wires would entail a drop in voltage of about 10 volts or more, so that the arc would burn with different voltages during a single run, depending on the length of the electrodes. In order to reduce this difference wires are inserted in the electrodes, as shown in the cross-sectional view, fig. 8. In *a* the wire is embedded in the core and pressed against the wall of the shell by coring the carbon. In *b* a special groove is provided for the wire in connection with the core hole, so that it is filled up with impregnating material when

coring the electrode. In *c* there is also a special hole for the wire, but separate from the core hole. It is, therefore, necessary to provide a good contact between the wire and the wall of the hole, and this is done in the manner indicated in fig. 9. The wire is first drawn through the hole till it projects out quite a distance. Then the part *l m* is crimped into the form shown in *b* by pressing it

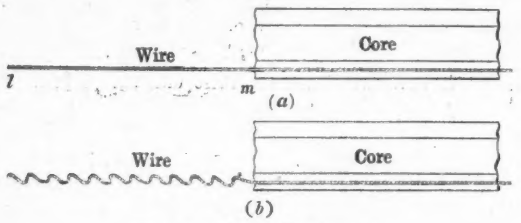


Fig. 9.—Wired Electrode.

between two toothed wheels. The crimped wire is then drawn back into the shell, pressing against the wall of the hole and making good contact. In electrodes of the construction shown in fig. 8*c*, where the wire is not prepared in the manner just described, the wire is of little or no use whatever, because there is not sufficient electrical contact between the wire and carbon.

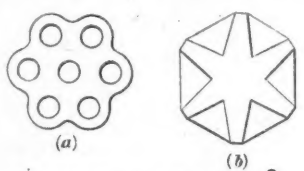


Fig. 10.—Electrodes for Regenerative Lamps.

At the upper end, where the electrode is to be fixed in the holder, the wire is flattened and wound around the end of the electrode, thus causing a better contact with the electrode holder. A firm in this country electroplates and solders the end of the electrode to obtain the same result. Zinc, brass, and tin wires are employed for this purpose. Brass wires can be used only in the construction shown in fig. 8*c*, where the wire is separated from the core. When this wire is surrounded by the core, as in the constructions shown in fig. 8*a* and *b*, brass cannot be used on account of the copper contained in it, which on oxidising covers the economiser of the lamp with a brown deposit. Aluminium wire has also been tried, but is found to be unsuited for this purpose, its surface soon being covered with a layer of oxide which insulates the wire from the carbon. The thickness of these wires varies from ½ mm. to ¾ mm. according to the thickness of the electrode.

The vertical electrodes for lamps of the Blondel type are distinguished by the thickness of their core, the latter forming about two-thirds of the entire diameter. These cores being too thick to be heated enough by the arc must, even when cold, be as good conductors of electricity as possible, so that the arc can move easily around the whole cross-section. For that reason organic binders, such as glucose, are used. The metallic salts in the core form 30 per cent. of the mixture only, while the carbon material comprises two kinds of baked lampblack of different mesh ; one-third being a coarse flour passed through a sieve of 30 mesh per inch on a sieve of 50 mesh, and the other two-thirds being the fine flour generally used for coring. The coarse flour is intended for making the core electrically better conducting as well as preventing the shrinkage of the core when dried. The metallic salts used for these electrodes are the same as those used in the flame-arc electrodes described above. Potassium salts and boric acid are added for supporting the arc, and take the place of the potassium silicate. The boric acid may be chemically compounded with the metallic salts.

Electrodes of quite another form are used in the regenerative lamps, fig. 9 showing characteristic cross-sections. The negative electrode, represented by *a*, contains seven cores made of the same material as the cores of common electrodes, while the shell consists of pure, first-class carbon material. The positive electrode, shown by *b*, contains a star-shaped central part, containing about 75 per cent. of carbon flour and 25 per cent. of calcium and alkaline salts mixed with boric acid. The triangular grooves between the ridges of this part are filled by a mixture of calcium, tungsten, and alkaline salts to which boric acid is added.

A pair of these electrodes has a life of 70 hours or more. The other flame-arc lamps have also been modified to give a longer electrode life, and since the shortness of life of the electrodes has been the chief obstacle to the extended use of flame-arc lamps in this country, a large development in street lighting by these lamps may be expected in the near future.

Tramway Club Concert.—The third annual grand concert of the band of the Metropolitan Electric Tramways Athletic and Social Club will be held at the Alexandra Palace on Thursday, May 4th, at 7.30 p.m. If the programme and artistes be as good as they were at last year's concert, and the Band in as excellent form, the evening should be a very enjoyable one.

SHANGHAI MUNICIPAL ELECTRICITY WORKS EXTENSIONS.

In our last issue we were only able to mention the tenders that were recommended for acceptance by Messrs. Preece, Cardew and Snell, the consulting engineers, and Mr. T. H. U. Aldridge, the Council's electrical engineer. We now make the following somewhat full extracts from the reports in order that our readers may note the reasons which have weighed with the experts in placing a large portion of the work with Continental manufacturers. Referring first to Section 1—Turbo-generators—the consulting engineers say that the specification issued provided for two sets of about 2,000 kw., with condensing plant. The exact size was not specified, as it was thought possible that some firms might have a standard size a little larger or smaller. Nor was the speed of the turbines definitely specified, it being stated that speeds of 1,500 and 3,000 revolutions would receive consideration ; these are the two standard speeds to give the correct periodicity for this size of plant. There was considerable divergence in the offers received. Many firms quoted alternatively, but the following are the best offers received from the various firms for different sizes of plant :—

Name of firm.	Maker of generator.	Price, £.	Size of plant, kw.	Speed r.p.m.	Steam at full load, lb.	Time for delivery. Weeks.
Richardsons, Westgarth & Co. ...	Siemens	12,025	2,000	3,000	14·66	40—44
Willans & Robinson	,,	12,050	,,	,,	15·15	34
A.E.G.	A.E.G.	12,455	,,	,,	14·45	21—26
Fraser & Chalmers...	Siemens	12,500	,,	,,	16·00	36—46
Brit. Westingh'se Co.	Brit. West.	12,547	,,	,,	14·9	28
Howden & Co. ...	Siemens	13,053	,,	,,	15·0	26—31
Escher Wyss & Co. ...	,,	13,164	,,	,,	14·4	25—29
B.T.-H. Co.	B.T.-H.	13,192	,,	,,	14·8	Subj. to tests
Oerlikon Co. ...	Oerlikon	13,290	2,500	,,	14·7	30—35
Brown, Boveri & Co.	Boveri	13,307	2,000	,,	15·4	40
A.E.G.	A.E.G.	14,225	2,000	1,500	15·4	22—26
Willans & Robinson	Siemens	14,360	2,000	,,	15·2	34
C. A. Parsons & Co.	Vickers	14,560	,,	,,	15·4	32
B.T.-H. Co.	B.T.-H.	14,580	,,	,,	16·25	22—26
A.E.G.	A.E.G.	15,025	,,	,,	14·75	22—26
Brit. Westingh'se Co.	Brit. West.	15,432	2,500	,,	15·9	28
Dick, Kerr & Co. ...	Dick, Kerr	15,454	,,	,,	15·1	36
Parsons & Co. ...	Parsons	15,861	2,000	,,	15·4	32
Brush Co.	Brush	16,036	2,500	,,	15·5	32
Escher Wyss & Co. ...	Siemens-Schuckert	16,282	2,000	,,	15·6	43
Howden & Co. ...	Siemens	16,933	,,	,,	15·0	26—31
Belliss & Morcom ...	,,	17,218	2,500	,,	14·72	40—42
Maschinen Augsburg	,,	17,638	,,	,,	14·8	40—42
Batt & Co.	,,	18,675	,,	,,	15·4	44—42

The report proceeds :—"Some tenders have also been sent in for 2,500-kw. plants at 3,000 revolutions. Messrs. Willans's tender was originally for 2,500 kw., but they subsequently sent in the alternative given above. Messrs. Bruce Peebles and the General Electric Co. quoted for the generator portion only.

"The price quoted by the British Westinghouse Co. was increased by £248 to provide a larger condenser. The Allgemeine Elektricitäts Gesellschaft, on the other hand, reduced their prices by £1,120, as they had included turbine-driven circulating water pumps, which were not specified. Various other tenders were slightly altered from the first prices received, due to modifications required to bring tenders upon the same basis.

"The foregoing schedule may be divided into two sections, (*a*) Tenders for turbines running at 1,500 r.p.m., and (*b*) Tenders for turbines at 3,000 revolutions. The higher speed means a lower price and a slightly better steam consumption. The saving in capital is about £3,000.

"We are ourselves in favour of the lower speed of 1,500 revolutions, especially for plant which has to be operated in isolated places such as Shanghai, but in view of the extra capital involved, we have decided to refer the matter for final decision to the Council.

"A difference of £3,000 on the capital may be of considerable importance, and as firms of repute are prepared to guarantee plant at 3,000 r.p.m., the Council may think it desirable in the interests of the undertaking to entrust the contract to one of these firms, although we think some risk is involved. The advance in the details of construction of plants of this character is very rapid, and what one looks upon as risky this year may possibly become common practice in a few years.

"Our chief objections to the high speed with turbines and generators of 2,000-kw. capacity or over are the mechanical difficulties in construction and the prevention of over-heating through want of ventilation. The peripheral speed of the rotor reaches some 20,000 ft. per minute, or 230 miles per hour, and it is obvious that a built-up rotor requires extremely careful workmanship and selection of material to ensure safety for continuous working at such speeds.

"As regards heating, the higher speed reduces the size of the rotor, but as the amount of heat generated remains almost the same, it is necessary to provide for a greatly increased supply of

air to carry off the heat. This is done by induced or forced draught. In Shanghai, the air in summer is over 90° F., and it is doubtful whether overheating can be avoided unless special water-cooling arrangements are adopted.

"Our opinion is largely confirmed by some firms who are not driven by modern competition to incur any risks to secure an order.

"The British Thomson-Houston Co., who carry out excellent work in England, and who are the British branch of the General Electric Co. of America, state definitely in their tender that though their practice in England is to use 3,000 revolutions for plant up to 2,000 KW., they do not think such speeds are desirable for plant in Shanghai. They have, however, submitted an alternative tender at this speed, but if accepted they would require to run the plant for three months before shipment to ensure its absolute safety.

"Assuming the Council accept our recommendation to adhere to 1,500 revolutions, the lowest tender is that of the Allgemeine Elektricitäts Gesellschaft at £14,225. They are followed by Messrs. Willans & Robinson, with Siemens generators at £14,360, Messrs. Parsons & Co. with Vickers, £14,560, the British Thomson-Houston Co. £14,580, the Allgemeine Elektricitäts Gesellschaft alternative £15,025, the British Westinghouse Co. (for 2,500 KW.) £15,432, and so on. There is very little difference between these tenders as regards construction of the turbine. They all have their particular advantages. The Allgemeine Elektricitäts Gesellschaft, the Westinghouse Co. and the British Thomson-Houston Co. are essentially of the impulse type, whereas Messrs. Willans, Parsons and Richardsons, Westgarth are combined impulse and reaction. With regard to the generators, the construction is different in most cases, but each firm is confident that its own is the best that can be made.

"The main difference, however, in these tenders is in the steam consumption. It will be noticed that the Allgemeine Elektricitäts Gesellschaft's higher tender gives the best steam consumption. This is due to the fact that they have more stages in the turbine. The British Thomson-Houston and other firms could improve their steam consumption if a similar alteration were made, but this again would bring their price up much above that of the Allgemeine Elektricitäts Gesellschaft.

"We recommend the tender of the Allgemeine Elektricitäts Gesellschaft, and prefer the higher tender at £15,025, in order to obtain the better steam consumption. We should much like to have recommended the tender of the British Thomson-Houston Co. Their turbine is excellent, and their generator is good. We have called their attention to the high steam consumption, but they preferred to adhere to what they guaranteed. They told us that they hoped they would get a better result, but they did not think they were justified in guaranteeing one. They also considered that the plant they had quoted was best suited for Shanghai, and might be expected to maintain the guarantee for many years.

"Should the Council decide to adopt the higher speed of 3,000 revolutions, we see no reason to reject the lowest tender—that of Messrs. Richardsons, Westgarth with Siemens generator. Messrs. Richardsons, Westgarth build turbines of the design by the well-known Swiss firm, Messrs. Brown Boveri & Co., and have done very good work in this country. Messrs. Siemens's generators are excellent, and we are satisfied that of the designs submitted for high-speed generators, the one proposed by them is probably the safest—its construction is very solid. The steam consumption of Messrs. Richardsons, Westgarth's tender is very good.

"The Allgemeine Elektricitäts Gesellschaft's steam consumption is slightly better than that of Richardsons, Westgarth, but the difference is so small that we do not think it can justify the additional expense of £430. The steam consumption of Messrs. Willans and Robinson's tender is not so good as Messrs. Richardsons, Westgarth offer, and the type of turbine they propose has no special advantages.

"The result of the above recommendation is that if the Council decide to adopt a speed of 3,000 revolutions, they should accept the tender of Messrs. Richardsons, Westgarth with Siemens generators, at £12,025; but, on the other hand, if they adopt our suggestion regarding the speed, they should accept the tender of the Allgemeine Elektricitäts Gesellschaft at £15,025.

"The sum provided by Mr. Aldridge was £30,000, including some pipe-work and sundries, which would amount to about £4,000. There is thus a considerable saving over the estimate.

"*Boiler House.*—In reply to our advertisement, tenders were received from the following firms:—

Howden & Co., Ltd.	£13,027
Clarke, Chapman & Co. (with alternatives) ...	14,264
Babcock & Wilcox, Ltd....	14,495
Hawksley Wild & Co.	15,028
Fraser & Chalmers	20,295

"Of the above tenders, Messrs. Howden propose a boiler which has not yet been thoroughly tested in the market. It is only in an experimental stage, and under these circumstances we did not think it advisable to consider their tender further. The next tender, that of Messrs. Clarke, Chapman & Co., proposes 'Woodeson' boilers, which is a satisfactory type, but in view of the fact that Messrs. Babcock & Wilcox's boilers are already installed in Shanghai, giving most satisfactory results, we prefer to adhere to their make, especially in view of the fact that the difference in price is so small.

"Messrs. Babcock & Wilcox had quoted in their tender for some additional work in connection with the chimneys, which is not required, and they are prepared to carry out the work specified for the sum of £14,305. Under these circumstances, we decided that their tender was the best to be accepted, and we are provisionally accepting their tender.

"The tenders of Messrs. Hawksley Wild and Messrs. Fraser and Chalmers do not offer any advantages over the other tenderers.

"The plant included in Messrs. Babcock & Wilcox's tender of £14,305 consists of the four boilers, stokers, economisers, steel shafts, flues and dampers, &c., but does not include the pipework. The sum provided by Mr. Aldridge for this section of the work was £18,000. Assuming the cost of the pipework does not exceed £2,000, which appears to us ample for the work, the total cost of this section will not exceed £16,500, or a saving of £1,500.

"*Main Switchgear.*—The following tenders have been received:—

Union Electric Co.	£1,415
Cowans, Ltd.	1,428
General Electric Co. (England)	1,445
British Westinghouse Co.	1,512
Cox-Walkers, Ltd....	1,515
Spagnoletti, Ltd.	1,571
Allgemeine Elektricitäts Gesellschaft	1,592
Siemens Bros. & Co., Ltd.	1,613
Johnson & Phillips	1,643
Bertram Thomas	1,753
Electric Construction Co.	1,798
Ferranti, Ltd.	1,817
Reyrolle, Ltd.	1,895
Brown, Boveri, Ltd.	1,985
British Thomson-Houston Co.	2,744
Crompton & Co., Ltd.	3,138

"The designs of boards and types of switches vary very much in character. We have carefully considered the different offers, and have concluded that the tender of the British Westinghouse Co., Ltd., is the most satisfactory in design at the price offered, and we propose to provisionally accept their tender.

"*Transformers.*—The following tenders have been received for the transformers required for the generating station, and for one of the first sub-stations:—

Allgemeine Elektricitäts Gesellschaft	£620
Brush Electrical Engineering Co., Ltd.	626
Johnson & Phillips	666
British Electric Transformer Co.	674
British Westinghouse Co.	680
Oerlikon Co....	680
Allgemeine Co. (alternative)	700
Siemens Bros. & Co., Ltd.	804

"The lowest tender, namely, that of the Allgemeine Elektricitäts Gesellschaft, is satisfactory, and we have provisionally accepted their tender at £620.

"*Cables.*—The following tenders have been received:—

R. R. Todd (The Lahmeyer Co.)	£12,078 15s.
Siemens Bros., London	12,079 5s.
Allgemeine Elektricitäts Gesellschaft ...	12,222
Western Electric Co., Ltd.	12,227
British Insulated and Helsby Cables, Ltd. ...	12,338
W. T. Henley's Telegraph Works	12,381
Callender's Cable Co., Ltd.	13,182
W. T. Glover & Co., Ltd.	13,325
Union Co....	14,031
General Electric Co., Ltd.	14,046

"We carefully considered the above tenders, and in view of the fact that Messrs. Siemens's cable will be made at Woolwich, while Mr. Todd's are made at Cologne, the extra cost of 10s. was fully justified, owing to the reduced expenses of inspection and testing in England as compared with Germany.

"We decided to provisionally accept Messrs. Siemens's tender.

"Preece, Cardew & Snell."

(To be continued.)

The Causes of Zero Displacement.—In a paper published in the *Physical Review* for March, 1911, Mr. A. Zeleny describes a series of investigations by which the zero displacement observed after a deflection in a moving-coil galvanometer is shown, for phosphor-bronze suspensions, to be due almost entirely to the change in the intensity and direction of magnetisation of the magnetic impurities within the coil. The amount due to a true set in the fibre is negligible under ordinary conditions of use, and in the cases investigated the largest true set observed was less than 6 per cent. of the whole zero displacement. The hysteresis curve of the magnetic impurities within the coil shows a very large coercive power, sufficient to account for the observed deflection hysteresis in moving-coil galvanometers. The upper bend of the curve is at a field intensity of about 1,600, which is great compared to the corresponding intensity for iron or steel. During the progress of the experiments several other properties of moving-coil galvanometers were investigated.

The moment due to the magnetism in the galvanometer coils was found to differ considerably even in instruments of the same type and from the same manufacturer. In the similar coils tested, the magnetic moment, less the diamagnetic moment, in the same field varied from 0·129 to 0·217 C.G.S. units.

The values of the damping factor for the same coil in fields of different intensities were determined. More than two-thirds of the damping on open circuit was found, for ordinary galvanometers, to be due to the resistance of the air and the internal friction of the fibre, and less than one-third to the induced currents.

SHIFT ENGINEERS.

[COMMUNICATED.]

During the past 15 or 20 years many central stations have sprung into existence, with the result that there is now a section of the community composed of shift engineers. These men are responsible for the operation of boilers, prime movers and dynamos, and the various other machines and contrivances which constitute the equipment of a power house, and upon their shoulders rests the responsibility of maintaining a continuous supply of electricity for lighting and various industrial purposes. Not infrequently the shift engineer is quite young, and it may seem that his experience is altogether inadequate for such a responsible calling, and that an older man would be more suitable for the post. But the fact remains, the care of millions of pounds' worth of machinery is entrusted to such men, and they appear to perform their work quite satisfactorily. What the shift engineer does when on duty may not be at all evident to an outsider on paying a casual visit to the works, nor, in fact, to many who are in the habit of coming in frequent contact with him. Still, he is the man in charge, and when troubles arise, he is looked to for the word of command.

Some shift engineers are remarkably lucky, and occasionally serve in this capacity for quite a number of years without anything serious happening. Such men are liable to gain the reputation of being good at their job, and so obtain excellent testimonials from their chiefs, although it is nothing but sheer luck which has provided them with such an excellent record. It is an unquestionable fact that the shift engineer of to-day has a lighter burden to bear than those who went before him, for, with modern plant, there is much less to go wrong, and that which does happen is attended with less disastrous consequences. Every accident that occurred in the early days taught the designer a new lesson, until now the chances of serious things happening have to a large extent disappeared. The design of switchboards, for example, has undergone marked improvement, and the same applies to almost every machine and piece of apparatus in the power house. Perhaps nothing has done more in the way of lightening the burden of the shift engineer than the introduction of the steam turbine. Compared with the reciprocating sets which were put down a few years ago, the turbine is an extremely simple machine and has little that is liable to get out of order. Apart from this, it has undoubtedly simplified the process of paralleling alternators, and what is most delightful of all, it seldom indulges in such sport as throwing the load about, or, in other words, it has little tendency to hunt.

Of all things that can happen in a power station, perhaps there are few more exciting than when the machines get out of step, and it is on such occasions that the shift engineer is afforded an opportunity of showing his usefulness, for if prompt and expedient measures are not taken, very undesirable results may follow, and the disturbance may be brought to a climax by a total shut-down. It is not always the man who is equipped with the best technical knowledge, and who knows exactly what to do in cases of emergency that proves the best shift engineer, for the power of keeping a cool head is an important factor. Not infrequently a man can answer almost any question concerning what he would do should troubles occur, yet, at the critical moment, he is practically useless. This arises from the fact that at such times he loses his head, and is liable to do things which only make matters worse. Sometimes when shift engineers are interviewed by chiefs in connection with an appointment they are put through a verbal examination, and the man who gives the most satisfactory answers gets the job, but often such men prove of little value when a breakdown actually occurs. A shift engineer was being examined by a chief who asked him a long list of questions, and finally put one to him concerning the boiler house. "Suppose," he said, "on opening the furnace door of a Lancashire boiler you found that the crown of the internal flue was red hot; what would you do under these circumstances?" "I should procure my hat and coat and clear out of it at the earliest possible moment," was the reply. What comment the chief made, history does not say, but the fact is on record that the man did not get the job.

There is another story about a shift engineer who had cultivated the habit of sleeping on the night shift. On one occasion, however, a main bearing had been giving considerable trouble by getting hot, and, as a consequence, his rest on that particular night was much disturbed, and the process of continually feeling the bearing had become positively tiring. But he was a man of resource, and soon invented a device which enabled him to take his customary sleep. After having removed his boots and socks, he placed his feet on the troublesome bearing, and soon was in the land of Nod. Shift engineers, unfortunately, often indulge in a nap on the night shift, but the practice is undesirable from more than one point of view. Naturally, the chief looks to the man he puts in charge to set his staff a good example, and of all things that a shift engineer should not do, nothing is worse than going to sleep whilst on duty. A shift engineer engaged in a certain central station who was in the habit of going to sleep woke up one night to find that the volts were extremely low. On investigating the cause, he discovered that the whole of his staff, including the stoker, had gone to sleep also, and he was not only surprised, but extremely angry. But what can a shift engineer reasonably say to his staff under those circumstances? By giving way to such self-indulgence he loses his authority, and if he threatens to report a man for sleeping he will probably be told to go to a hotter place than the boiler house. Many chiefs endeavour to keep their shift engineers fully occupied during the night shift, and the system is to be highly commended. The plotting of load curves, testing of feed water and the superintendence of minor repairs, such as joint making, gland packing and other work that can be executed by the running staff can well be carried out during the night, and will afford a means of passing many weary hours.

There is not the least doubt that the life of a shift engineer is not one of the most desirable, and it is by no means surprising to find that many of them are dissatisfied with their lot. The shift engineer works when others play, his pay is small, and his duties are monotonous. His meals are taken at irregular hours, and altogether his life is unnatural. Perhaps he will go on for years without anything happening which will afford him an opportunity of distinguishing himself or "getting the sack." Possibly his chance will never come, and if it does, and he is successful in preventing a serious breakdown, his chief will fail to recognise the fact. No wonder the shift engineer grumbles. But there is another side to the question. Many young men engaged in this capacity seem to think that they have learnt all there is to know, and that however much they may try, there is no new knowledge pertaining to the running of central stations that is worth acquiring. In most cases, however, such a conclusion is totally erroneous, as almost any shift man can readily prove for himself. Let him look round and ask himself whether he thoroughly understands the principle on which the whole of the plant works. If the shift engineer is constantly asking himself the reason for everything, he will find that his mind is rarely unoccupied, and his work will become less monotonous. Truly speaking, a shift engineer has excellent opportunities for improving his knowledge, for, unlike many other occupations, his does not demand much concentration of thought. The man connected with a works, on the other hand, needs constantly to be thinking of what he is doing, and cannot be dreaming about the theory of the turbine whilst engaged on dynamo design. It should not be supposed that shift engineers should always have their minds on complex problems, for such a procedure is naturally liable to prove detrimental to their work, but, at the same time, there are many occasions on which they may indulge in a little reasoning; and on the night shift, when things are slack, a little quiet study may be excusable. At all events, it is preferable to the practice of taking a nap. The man who makes it his duty only to see that the volts are never low, and that no part of the plant breaks down, is the one who finds his work most uninteresting, and it is he who usually does the most grumbling. Many shift engineers seem to overlook the fact that they are supposed to run the plant economically, and fail to take an interest in such things as the economical utilisation of coal and the maintenance of a good vacuum.

Almost every shift engineer in existence is desirous of obtaining a better job, and when an advertisement appears in the technical Press for a station superintendent, the number of applications from these men is something alarming. The irregular hours, the general monotony of the work and the small pay which the shift engineer receives are undoubtedly responsible for the craving on the part of so many men to get a different job, and this eagerness to depart from shift work is not surprising. There are hundreds of shift engineers who will tell you that influence alone can promote them to a higher standard, and that practically all the better positions are filled before they are advertised. Perhaps this is correct in a few cases, but the failure of so many shift men to improve their positions can better be explained in other ways. Many seem to overlook the fact that the demand for station superintendents and chief engineers is very much less than the demand for men to take charge of shifts. In practically every station there are at least three shift engineers to every station superintendent or chief, and it is not surprising to discover that many shift men find difficulty in improving their positions. What is the shift engineer to do then? It is not easy to give advice in this matter, but, perhaps, if many who are at present engaged in shift work were to turn their attention to appointments outside central stations, it is possible that they might meet with more success.

Provided a shift engineer has received a proper engineering training, and is smart and not afraid of work, he should not experience great difficulty in finding employment with manufacturing firms. Builders of steam engines and turbines, for example, are sometimes in need of young men who can take charge of their testing departments, and who can go out on jobs and carry out tests in power houses. A man who has served in the capacity of a shift engineer knows the conditions under which a power house is run, and is more likely to satisfy a firm's clients than one who is devoid of central station experience. He knows better what to do to please chief engineers; and if a new machine is inclined to be troublesome, he appreciates the annoyance it may cause and will strive hard to get the station staff out of difficulties. He thoroughly understands that under no circumstances must the bus-bar volts fluctuate, and that he must not attempt to make any alterations to switchboards or other connections without first informing the man in charge. Many engineers lacking central station experience get on well enough so long as they remain in the works, but often seem to forget that the conditions which prevail in central stations are somewhat different. Certain manufacturing firms appear to appreciate these facts, and are willing to give work to shift engineers, provided that they are really good men. On joining a contracting firm a shift engineer may not better himself immediately; but he should remember that if he possesses real ability he has a far better chance of showing it. Manufacturing firms always appreciate an outside engineer who has the knack of overcoming difficulties, and in this capacity a good man can eventually command a fairly respectable salary, or, at all events, more than he is likely to get at shift work. Moreover, such a position often serves as a stepping stone to something better on the central station side of the profession, for time served with contractors is always well spent. Usually a man with central station experience, who has also held a fairly responsible position with a manufacturing firm, stands a better chance of rising to be a chief engineer than one who has devoted most of his time to shift work. Experience gained with contractors is always valuable, and it is desirable that young engineers should do all in their power to get employment in that field. Many shift engineers are devoid of mains experience, and this undoubtedly often prevents them from making headway. In view of the conditions under which shift engineers work, and the irregularity of their hours, it seems that it would be an excellent thing if chiefs would endeavour to let them take a turn outside. In many central stations an assistant mains superintendent is kept, and by employing a man who is qualified to take charge of a shift, he could act in both capacities and work on the mains one week in every four. Each shift engineer could work in the station from, say, 7 a.m. to 3 p.m. one week, 3 p.m. to 11 p.m. the next week, and from 11 p.m. to 7 a.m. the third week. On the fourth week he would be engaged outside on the mains. Many chief engineers will ask, But what does the average shift engineer know about mains? Very little, perhaps, but still a man equipped with a good technical training will soon make himself acquainted with the work, and there is no doubt there are many shift engineers to-day who would be only too glad of the opportunity of doing so. Unfortunately the tendency of the present time is to make every man stick to a certain department, and as a result young engineers often find the task of getting on extremely difficult. In the manufacturer's works this tendency predominates to an even greater extent, and so surely as a man makes himself proficient at a certain job, he will be kept at the work, perhaps for years, and in this way the progress of many hard workers is often retarded.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

URUGUAY.—The exact net and gross weights in kilogrammes should be marked on each package and specified on invoices, bills of lading, &c.; the net weight of each class of goods should be stated, and the country of origin of the goods should be given on all documents. It is advisable that invoices should be made out in Spanish. Invoices must be certified to be true and correct, the total amount must be inserted at length and the whole document must be signed by the merchant. It is not absolutely essential that the invoices should be legalised by a Consul, but it is preferable that they should be.

Duties are leviable in percentages of values fixed by the Customs. The usual percentage is 31 per cent., but in some cases other percentages are in force and are stated after the following valuations. It will be understood that the following are merely values as fixed by the Customs, and the actual amount of duty leviable is ascertained by taking the fixed percentage of these values. In addition there are surtaxes in force amounting to 15 per cent. of the total duty levied at the rates given below:—

	Values. Pesos.	Per-centage.
Wire, of brass or copper	·48 per kg.	31
„ galvanised iron	·10 „	31
„ iron, polished	·07 „	31
Scientific apparatus ...According to appraisement.		6
Pumps, of iron up to No. 4	40 per doz.	31
„ „ Nos. 1 to 3	10 each.	31
Globes, metal for lamps	4·80 per doz.	31
Machines for industrial works and parts for the same ... ...According to appraisement.		5
Tramway cars, closed	1,000 each.	48
„ „ open	800 „	48
Bells	2 „	31

Electrical goods not capable of being included under one of the above headings would probably be dutiable at the rate of 31 per cent. on a value fixed at the time of importation.

VENEZUELA.—The exact net and gross weight in kilogrammes should be marked on each package and specified on invoices, bills of lading, &c.; the net weight of each class of goods should be stated and the country of origin should be given on all documents. Invoices must be made out in quadruplicate on special forms which may be obtained from the Venezuelan Consuls. These invoices must be signed by the Consul at the port of shipment, a fee of 16s. being charged for invoices of a value up to £50, with an additional 4s. for every additional £80. If there is more than one mark included on the invoice a fee of 4s. additional is charged. A declaration certifying that the invoice is true and correct must be appended to the document and must be signed by the merchant. The following duties are leviable; in addition there are surtaxes of 30 per cent. and 25 per cent. on all imported goods, and a further surtax of 1 per cent. on the total amount payable, so that the amount of the duty payable at the rates given below must be increased by 55 per cent., and that total further increased by 1 per cent.

25 bolivares = £1.

Goods dutiable at ·05 bolivar per kg.:—

Apparatus and machines for generating steam by means of petroleum, naphtha.
Gas or electric lighting apparatus and machinery.
Carriages, accessories and materials exclusively intended for railroads.
Telegraphic apparatus and machinery.
Steam engines of all kinds, with their accessories.
Gas engines hydraulic engines and petrol engines.

Goods dutiable at '10 bolivar per kg. :—

Conduits or pipes, of iron or lead.
Cranes.
Machinery not mentioned above whose total weight does not exceed 1,000 kg.
Iron or steel posts for electrical installations.

Goods dutiable at the rate of '25 bolivar per kg. :—

Telephonic apparatus and adjuncts, such as commutators, pins, cranks, insulators and wooden rods, carbons, and covered copper wire for telephones, lamps and accessories for the installation of electric light.
Electric bells and their accessories.

Goods dutiable at '75 bolivar per kg. :—

Chandeliers, candelabra, lamps.

The following goods are admitted free of duty :—

Articles imported by the Government, machinery for use in agriculture, mining, weaving, saw-mills, and foundries, not otherwise mentioned.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

8,247. "Mechanism in a box which will, by inserting a coin in a slot, run an electric model train or any electrically-driven show piece for any certain limited time." W. E. A. Guelke. April 3rd.

8,261. "Process or means for producing a substitute for india-rubber compounds by electro-chemical volatilisation from hydrocarbon liquid compounds, and condensing and combining the same with cellulose solutions." E. M. Bailey and B. Bailey. April 3rd.

8,272. "Non-inductive anti-capacity slide wire resistances." C. E. Hay. April 3rd.

8,275. "Electrical resistances and controlling devices." G. N. Ogilvie and Adams Watkin Co., Ltd. April 3rd.

8,283. "Selective electric signalling over a number of conductors." G. H. Crook. April 3rd. (Complete.)

8,340. "Magneto-electric machine." L. Lindos. April 3rd. (Complete.)

8,356. "Hydraulically-balanced electric lifts." E. M. T. Boddam. April 4th.

8,375. "Electric wall plugs and sockets." H. Hirst and F. M. Chapman. April 4th.

8,387. "Method of and means for receiving electric waves." R. Goldschmidt. (Convention date, April 4th, 1910, Germany.) April 4th. (Complete.)

8,392. "Ventilation of dynamo-electric machines." Siemens Bros. Dynamo Works, Ltd., and C. A. B. D. Koettgen. April 4th. (Complete.)

8,397. "Means for magnifying small mechanical or electrical effects." E. S. Heurtley. April 4th.

8,400. "Electrical footwarmer." L. Frosali and L. Visconti. April 4th.

8,411. "Sparking plugs." H. H. Hurt and C. J. Hurt. April 4th.

8,446. "Electric batteries." C. V. A. Eley. April 4th.

8,460. "Electrical earthing device." S. C. Barton and J. Carter. April 5th.

8,484. "Bonding devices for electric cables and electric fittings." S. W. Martyn. (Divided application on 9,921/1910. April 23rd.) April 5th.

8,489. "Control of alternating-current electric motors." R. H. Barbour. April 5th.

8,515. "Electric switches." B. C. Johnson. April 5th.

8,522. "Device for driving the magneto of a motor cycle or car and at the same time advancing or retarding the position of the spark in the stroke." C. C. Vassal Taylor. April 5th.

8,524. "Arrangement for producing slightly damped electric oscillations." B. Macku. (Convention date, May 2nd, 1910, Austria.) April 5th. (Complete.)

8,566. "Means for locking electric incandescent lamps to their holders." W. C. Keene. April 6th.

8,585. "Electrical time switches." S. Chiger. April 6th.

8,589. "Direct current machines." J. H. Garrick and Greenwood and Batley, Ltd. April 6th.

8,591. "Speed control of electric motors." Siemens Bros. Dynamo Works, Ltd., and F. Lydall. April 6th. (Complete.)

8,592. "Starting of alternating-current electric motors." Siemens Bros. Dynamo Works, Ltd., and M. Kloss. April 6th.

8,656. "Brush for electric engines." G. Engisch. April 7th.

8,665. "Electrical toasting and like heating apparatus." F. Barron. April 7th.

8,688. "Method of providing temporary auxiliary electrical current in case of failure or partial failure of the main source of supply, and apparatus and appliances connected therewith." J. J. Robins and S. Walford-Grout. April 7th.

8,710. "Sparking plug." W. A. P. Werner. April 7th.

8,712. "Arrangement for producing slightly damped electric oscillations." Ges. fur Drahtlose Telegraphie M.b.H. (Convention date November 2nd, 1910, Austria.) April 7th. (Complete.)

8,720. "Rotary electric contacts." J. E. F. C. Pechin. April 7th.

8,753. "Concentric shafting driven by steam or other turbines, electric motors, and the like." J. Dunn, Jun. April 8th.

8,767. "Electric switches." P. Druseidt. (Addition to 9,399, 1910.) April 8th (Complete.)

8,783. "Control systems for alternating current electric motors." L. V. Lewis. (Convention date, April 9th, 1910, United States.) April 8th. (Complete.)

8,798. "Electrically-controlled grab hoisting gear." K. Brull. (Convention date, October 10th, 1910, Germany.) April 8th. (Complete.)

8,806. "Wireless telegraphy." Sir Oliver J. Lodge and E. E. Robinson. April 8th.

France.—A new company has just been formed in Paris (167, Rue Montmartre), with a capital of £14,000 and the title La Société de l'Energie Electrique de la Manche.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1908.

Manufacture of Filaments for Electric Incandescent Lamps from Tungsten or Alloys thereof. A. G. Bloxam. (Siemens & Halske Akt.-Ges.) 19,632. September 22nd. (Convention date not granted.)

1909.

Electric Lamps and Filaments. H. T. Grainger. 18,799. August 16th. (March 16th, 1910.)

1910.

Electric Supply Systems and Apparatus for Motor-Cars and the like. R. F. Hall. 6,312. March 14th. (Cognate applications, Nos. 8,155, 9,926, 12,893, and 17,330 of 1910.)

Arc Lamps having Two or more Pairs of Electrodes. H. P. Bleckly. 6,536. March 15th.

Electric Light Pendant Fittings. L. Waterhouse. 6,595. March 16th.

Dynamo-Electric Machines. F. von Zweigbergk. 6,624. March 16th.

Dynamo-Electric Machines of the Homopolar Type. L. K. Loring. 6,634. March 16th.

Electric Furnaces and the Method of Charging the same. Stora Kopparbergs Bergslags Aktie Bolag. 6,768. March 17th. (March 19th, 1909.)

Ceiling Roses, Wall Plugs, and like Electrical Fittings. J. S. Highfield. 7,929. April 1st.

Electric Generation and Electric Superheating of Steam. I. de Holden-Stone. 8,005. April 2nd.

Arc Lamps. R. H. Burkitt. 8,380. April 7th.

Manufacture of Incandescent Electric Lamps. F. Harrison. 10,874. May 3rd.

Detachable Power Handle for use on Electrical Controllers on Tramcars, Motor-Cars, Trains and the like. R. Chadwick and C. Clarke. 11,569. May 16th.

Electric Switch. L. B. de Laitte and Safety Light, Ltd. 12,347. May 19th.

Control and Protection of Electric Motors. British Thomson-Houston Co. (General Electric Co.) 13,123. May 30th.

Systems of Electrical Distribution. British Thomson-Houston Co. and A. R. Everest. 13,124. May 30th.

Apparatus for the Production of Electrical Flashes, more particularly suitable for use with Advertising Devices. H. V. Good. 13,298. June 1st.

Vapour Electric Lamps, such, for instance, as Mercury-Vapour Lamps. J. H. Vincent. 13,405. June 2nd.

Dynamo-Electric Machines. British Thomson-Houston Co. (General Electric Co.) 13,410. June 2nd.

Electrical Contact Device. O. Engel. 15,150. June 23rd. (Convention date not granted. Addition to No. 6,765 of 1908.)

Electrical Switches Operated by a Vehicle Passing Along a Railway. E. C. Moore. 15,564. June 28th.

Systems for the Distribution of Electric Energy. W. F. Anderson, S. A. Russell and W. E. Gray. 15,618. June 29th. (Addition to No. 21,219 of 1909.)

Manufacture of Electric Metal-Filament Lamps. F. Skaupy. 15,621. June 29th. (December 6th, 1909.)

Control Devices for Electric Cars on routes in which two different voltages are supplied. Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke Ges.) 17,595. July 28th.

Electric Switches. W. Fairweather. (Hart Mfg. Co.) 18,344. April 3rd.

Cooling Dynamo-Electric Machines. Siemens Bros. Dynamo Works, Ltd. (Siemens-schuckertwerke Ges.) 20,491. September 2nd. (Patent of Addition not granted.)

Substation Telephone. W. Fairweather. (Stein.) 22,410. September 27th

Manufacture for Metal-Filament Electric Lamps. Schroter. 23,121. (January 19th, 1910.)

Electrolytic Cells for the Electrolysis of Alkaline Salts. W. Wildermann. 26,568. November 15th. (December 22nd, 1909.)

Device for Utilising the Heat of the Sun by Converting it into Electrical Energy. F. Joh and J. Wolf. 26,782. November 17th.

Electric Motors. W. R. Macdonald. 29,593. December 20th.

Industrial Finance.—With reference to the meeting arranged by the National Electrical Manufacturers' Association for Tuesday next, April 25th (Institution of Electrical Engineers, Victoria Embankment, at 8 o'clock), we learn from Mr. Hawes, the Association secretary, that Mr. Joseph in his paper on "Foreign compared with Home Industrial Finance," will handle the subject to a large extent from the point of view of the electrical industry. A considerable attendance of leading electrical manufacturers, as well as bankers and others interested entirely in the financial side, is anticipated. Among those expected to take part in the discussion are Messrs. H. Hirst, A. Bruce Anderson, and Mr. Faithfull Begg (of the London Stock Exchange).

West Ham.—The Electric Lighting and Tramways Committee has considered a joint report from the electrical engineer and the tramways manager on the supply of energy from the generating station for traction purposes, and the extension of the system of feeder cables, and has decided that the following works be carried out at a total cost of £8,925 :—(*a*) To extend the existing D.C. cables from the Stratford Town Hall to the Chapel Street sub-station and install rotary converters there; estimated cost—cable, £2,000; sub-station equipment, £400; switchgear and cables in sub-station, £1,250; converter, £1,600; extension of cables from Town Hall, £750. (*b*) To extend feeder cable down Romford Road, estimated cost, £1,400. (*c*) To extend feeder cable in Leytonstone Road, estimated cost, £100. (*d*) To extend the return cable in Barking Road, estimated cost £1,425.